Canadian Conservation Institute
Institut canadien de conservation

Research & Development Projects
Canadian Conservation Institute
1999-2000

Conservation and Scientific Services
Canadian Conservation Institute
Department of Canadian Heritage
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Canadian Heritage Patrimoine canadien

Canada

Title:	**The Materials and Techniques of Jean Dallaire (1916-1965)**
Purpose:	To analyse the materials and document the techniques used by Jean Dallaire in order to build a database which will assist in devising treatments and selecting appropriate display and storage conditions. The project will provide reference analyses for paintings for which the attribution is uncertain
Dates:	June 1998 to June 2002
Team:	Marie-Claude Corbeil,* Kate Helwig, Claude Belleau, Yanick Rainville, and Karen Lawford
Description:	This project was initiated in conjunction with an exhibition organized by the Musée du Québec, to take place in the Summer of 1999. Twenty-five paintings from 6 institutions were selected for this project by Michèle Grandbois, Curator of Modern Art, Musée du Québec. Cross-sections and samples of canvas, ground, paint, and varnish, were collected. Information regarding the execution of the art works was also documented, such as the kind of support used (masonite *versus* canvas, commercially prepared canvas *versus* canvas prepared by the artist), the presence and appearance of signature, *etc.* A condition survey will be done.
Users:	curators, conservators, scientists, art historians, artists and the general public in Canada and internationally.
Links/Partnerships:	This project was initiated at the request of Musée du Québec
Results:	
Publications:	
Division:	ARL
Number:	

Title:	**Analysis, Conservation, and Recording of Rock Paintings and Petroglyphs**
Purpose:	Investigate the causes of deterioration of rock painting and petroglyph sites and develop preservation and protection strategies and methods; identify rock painting pigments, accretions, biological growths, and graffiti materials; characterize the nature of the superposition and interaction of rock substrate, pigment, accretions; develop photographic and digital image processing methods for recording rock art sites for research and posterity.
Dates:	1972 to 2002
Team:	Ian N.M. Wainwright,* Kate Helwig, P. Jane Sirois, Jeremy J. Powell, Carl Bigras, (In addition, other researchers at CCI — especially Gregory S. Young, Marilyn E. Laver, Stefan Michalski, Tom Stone, and Nancy Binnie — have contributed to this research)
Description:	Rock painting and petroglyph sites are subject to both natural weathering and visitor impact. The focus of this research project is the investigation of the causes of natural deterioration of rock art sites by means of field observations, monitoring, and laboratory analysis for several sites in Canada and abroad. Agents of natural weathering include frost weathering, dissolution, lichen and algae, and silcrete deposition. Methods for recording sites such as electronic flash photography, recording from frozen lake surfaces, and digital image processing for enhancing photographic images are being studied to develop effective recording strategies. Graffiti treatment methods are under investigation.
Users:	archaeologists, archaeological conservators, curators, cultural resource managers, park interpreters and planners, scientists. A seminar, "Analysis, Recording and Conservation of Rock Paintings and Petroglyphs," is available and has been given at Dartmouth, Quebec City; Montevideo (Uruguay), and Buenos Aires (Argentina).
Links/Partnerships:	Ministry of Natural Resources (Ontario); Sears and Russell Architects (Toronto); several First Nations; Heritage Recording (Public Works and Government Services Canada); Instituto Nacional de Antropología y Pensamiento Latinoamericano (Argentina) on the analysis of rock painting sites in Santa Cruz and Catamarca provinces and with the Archaeological Museum Aruba on the analysis of sites in Aruba. Conservation strategies are also been developed with the Comisión Nacional de Arqueología (Uruguay) for various sites in Uruguay. A multi-year photographic recording project at the Mazinaw Lake rock painting complex is a collaboration with staff of Bon Echo Provincial Park, Ministry of Natural Resources (Ontario).
Results:	A bibliography of articles, presentations and seminars is available on request. A review of rock art recording methods was published in the *APT Bulletin* in 1990.

Publications:

Wainwright, I.N.M., Sears, H., and Michalski, S., "Design of a Rock Art Protective Structure at Petroglyphs Provincial Park, Ontario, Canada," *Journal of the Canadian Association for Conservation*, vol. 22, 1997, pp. 53-76.

Laver, M.E. and Wainwright, I.N.M., "An Investigation of the Dissolution of a Marble Petroglyph Site by Acidic Precipitation," *Studies in Conservation*, vol. 40, no. 4, November 1995, pp. 265-273.

Wainwright, I.N.M. and Stone, T.G., "Experiments to Remove Wax Crayon from Petroglyphs in Marble," Chapter 3 in: *American Indian Rock Art*, vol. 16, *Proceedings of the International Rock Art Conference and 16th Annual Meeting of the American Rock Art Research Association*, Edited by S.A. Turpin (Austin: American Rock Art Research Association and Texas Archaeological Research Laboratory, The University of Texas at Austin, 1990), pp. 21-33.

Young, G.S. and Wainwright, I.N.M., "The Control of Algal Biodeterioration of a Marble Petroglyph Site," *Studies in Conservation*, vol. 40. no. 2, May 1995, pp. 82-92.

Wainwright, I.N.M., "Conservación y Registro de Pinturas Rupestres y Petroglifos en Canadá," in: *Administración y Conservación de Sitios de Arte Rupestre*, Contribuciones al Estudio del Arte Rupestre Sudamericano, no. 4, Edited by Matthias Strecker and Freddy Taboada Téllez (La Paz, Bolivia: Sociedad de Investigación del Arte Rupestre de Bolivia, 1995), pp. 52-82. [ISSN 1017-4354]

Wainwright, I.N.M., "Rock Painting and Petroglyph Recording Projects in Canada," *Association for Preservation Technology Bulletin*, vol. 22, no. ½, 1990, pp. 55-84.

Division: ARL

Number:

Title:	**Iron Oxide Pigments: Natural and Synthetic**
Purpose:	To undertake research on the history and characteristics of the iron oxide pigments and to prepare a manuscript "Iron Oxide Pigments: Natural and Synthetic," for inclusion in *Artists' Pigments: A Handbook of their History and Characteristics*, vol. 4, Barbara H. Berrie, Editor, to be published by the National Gallery of Art, Washington.
Dates:	1994 to 2000
Team:	Kate Helwig* and Ian N.M. Wainwright
Description:	The provisional section headings for the Chapter, subject to modification or omission, are as follows: *Introduction* (pigment definition; current terminology); *History* (archaic and historical names; history of use; dates of use); *General Pigment Properties* (colour and spectral reflectance; optical properties; permanence; chemical properties; compatibility; oil absorption and grinding properties; toxicity); *Composition* (chemical composition; sources; preparation; adulteration and sophistication); *Identification and Characterization* (optical and chemical microscopy; chemical identification; instrumental methods of analysis, *e.g.* x-ray powder diffraction, infrared spectroscopy; spectrochemical analysis; criteria for identification); *Occurrences*.
Users:	National Gallery of Art, Washington (publisher); curators, conservators, scientists, art historians, artists and the general public in Canada and internationally.
Links/Partnerships:	National Gallery of Art (Washington); pigment manufacturers; CCI Library; Material Technology Laboratory, Natural Resources Canada; Surface Science Western; Nancy Binnie, Conservation Processes and Materials Research, CCI (colour measurement studies)
Results:	June 1994-March 1996: literature search completed. References imported into "Reference Manager" software for ease of retrieval and production of a bibliography. Collection of reference materials was completed although samples of particular interest are still being solicited. Analysis of reference materials by FTIR, SEM/XES, PLM and XRD was initiated. April 1997 to April 1999: A draft manuscript of all sections, excluding *Identification and Characterization*, was completed. Analysis of standard samples continued. September 1999: The completed manuscript with illustrations and references was sent to the National Gallery of Art in Washington.

Publications:

Helwig, K. "A Note on Burnt Yellow Earth Pigments: Documentary Sources and Scientific Analysis," *Studies in Conservation,* vol. 42, no. 3, 1997, pp 181-188.

Helwig, K. "Characterisation of the Iron Earth Pigments Using Infrared Spectroscopy," *Postprints of the Infrared Users Group Meeting*, Victoria & Albert Museum, London, September 12-13, 1995 (1998)

Helwig, K, "Pigment Research at CCI: From Titanium Whites to Iron Oxides," *CCI Newsletter*, No. 21, March 1998, p. 5.

Helwig, K., "Mars Colours: Preparation Methods and Chemical Composition," *Poster Summary Booklet, Preprints of Painting Techniques: History, Materials and Studio Practice*, 17th International IIC Congress, Dublin, Ireland, 1998.

Helwig, K., "Characterization of the Iron Oxide Pigments Using Physical and Chemical Analysis," Presented at the AGPIC 1998 Student Conference, Queen's University, Kingston, Ontario, 2 May 1998.

Helwig, K., "The Iron Oxide Pigments: From Red Earth to Mars Colours," Presented at the 44th International Conference on Analytical Sciences and Spectroscopy at Queen's University, Kingston, Ontario, 9 August 1998.

Division: ARL

Number:

Title:	**The Materials and Techniques of David B. Milne (1982-1952)**
Purpose:	To analyse the materials and document the techniques used by David Milne for his oil paintings throughout his career in order to build a database which will assist in devising treatments and selecting appropriate display and storage conditions. The project will provide reference analyses for paintings for which the attribution is uncertain.
Dates:	September 1991 - March 2000
Team:	P. Jane Sirois,* Elizabeth A. Moffatt, David Miller, Kate Helwig, Jeremy J. Powell, Kristopher Legate, and Annaïg Gautier
Description:	This information will assist conservators and curators by providing essential data on Milne's materials and techniques which are used both in authenticity and attribution studies, and in evaluating the conservation requirements of his works.
Users:	curators, conservators, scientists, art historians, artists, law enforcement agencies, collectors, and the general public in Canada and internationally.
Links/Partnerships:	The project was initiated at the request of The McMichael Canadian Art Collection
Results:	Samples were taken from 37 paintings spanning David Milne's career from 1911 to 1946 belonging to The Milne Family collection, The National Gallery of Canada, the McMichael Canadian Art Collection and the Art Gallery of Ontario. In addition to these, other samples have been taken from David Milne's palette and paintbox. The SEM/XES and XRD of all the samples has been completed; FTIR is well underway as is the cross-section preparation and analysis. Polarized light microscopy remains to be done on all samples from paintings after 1917.
Publications:	Sirois, P.J., Moffatt, E.A., Miller, D., Helwig, Kate. "A Material and Technical Investigation of Early Oil Paintings by David Milne," *Presented at the IIC-CG Annual Conference*, Calgary, May 1995. (lecture) Sirois, P.J., Gautier, A., Miller, D., Moffatt, E. A., and Powell, J.J. "A Scientific Investigation of the Paintboxes of Paul Kane and David Milne," *presented at the IIC-CG annual conference*, Montreal, May 1996. (poster) Sirois, P.J., "Delving into the Paintboxes of Paul Kane and David Milne," *Newsletter, Canadian Conservation Institute*, no. 19, March 1997, pp. 6-7
Division:	ARL
Number:	
Title:	**Titanium Dioxide Whites**

Purpose: To undertake research on the history and characteristics of the titanium dioxide white pigments and to prepare a manuscript "Titanium Dioxide Whites" for *Artists' Pigments: A Handbook of their History and Characteristics*, vol. 3, Elisabeth West FitzHugh, Editor (Washington: National Gallery of Art, 1997), pp. 295-355.

Dates: 1983 to 1997 (Project completed)

Team: Marilyn Laver*

Description: The section headings for the Chapter are:

Introduction (pigment definition; current terminology); *History* (archaic and historical names; history of development; development of the sulfate process; development of the chloride process; additives and surface treatments; history of use); *General Pigment Properties* (colour and spectral reflectance; hiding power and tinting strength; permanence; compatibility; chemical properties; oil absorption and grinding properties; toxicity); *Composition* (chemical composition; sources; preparation; pigment grades, adulteration and sophistication); *Identification and Characterization* (optical microscopy; chemical identification; instrumental methods of analysis, x-ray diffraction, infrared and Raman spectroscopy; spectrochemical analysis; scanning electron microscopy and transmission electron microscopy, x-ray spectrometry, neutron activation, x-radiography, neutron radiography and autoradiography, thermal analysis, criteria for identification); *Occurrences*.

Users: National Gallery of Art, Washington (publisher); curators, conservators, scientists, art historians, artists and the general public in Canada and internationally.

Links/Partnerships: National Gallery of Art (Washington); many manufacturers provided samples and expertise; CCI Library; ARL colleagues for related analytical work; review of patent literature by Judi Miller and Jane Sirois

Results:

Publications: Laver, Marilyn E., "Titanium Dioxide Whites" in *Artists' Pigments: A Handbook of their History and Characteristics*, vol. 3, Elisabeth West FitzHugh, Editor (Washington: National Gallery of Art, 1997), pp. 295-355.

Division: ARL

Number:

Title:	**Analysis of Paints from Canadian Ethnographic Collections**
Purpose:	The goal of the project was to analyse paint samples from ethnographic artifacts in Canadian museum collections in order to establish a chronological database of the pigments and binding media used in various regions from pre-contact times to the beginning of the twentieth century.
Dates:	1984 to 1990 (Project completed)
Team:	Elizabeth A. Moffatt*, Judi Miller and P. Jane Sirois
Description:	The project was initiated in 1984 and essentially completed in 1990. The data provided information on the introduction of trade pigments and the decline of indigenous pigments in each region. Current work is limited to responding to requests from museums for information and to analysing a limited number of well documented samples to augment the data.
Users:	curators, conservators, scientists, anthropologists, and the general public in Canada and internationally.
Links/Partnerships:	Canadian Museum of Civilization; Glenbow Museum; Manitoba Museum of Man and Nature; Provincial Museum of Alberta; Royal British Columbia Museum; Royal Ontario Museum; University of British Columbia Museum of Anthropology; Ethnographic Museum of Sweden; National Museum of Denmark; Peabody Museum; Royal Scottish Museum
Results:	A total of 1346 paint samples were analysed during the original study. Most samples were from artifacts in the collections of seven Canadian museums; however, a limited number of early samples obtained from four European and American museums. Most artifacts were representative of Plains and Northwest Coast cultures. While the earliest documented samples date from 1780, the majority of artifacts sampled were collected after 1878. All samples were analysed by Fourier transform infrared spectroscopy and scanning electron microscopy/x-ray energy spectrometry. Many samples were also analysed by x-ray diffraction or polarized light microscopy.

Publications:

Moffatt, E. A., P. J. Sirois, and J. Miller, "Analysis of Paints Used to Decorate Northern Plains Hide Artifacts during the Nineteenth and Early Twentieth Centuries," *J. Canadian Association for Conservation*, vol. 22, 1997, pp. 39-52.

Moffatt, E. A., P. J. Sirois and J. Miller, "Analysis of Paints on a Selection of Naskapi Artifacts in Ethnographic Collections," *Studies in Conservation*, vol. 42, 1997, pp. 65-73.

Miller, J., E. Moffatt and J. Sirois, *Native Materials Project Final Report*, November 1990.

Detailed individual reports were sent to the participating museums in October 1990:

"The Use of Historic Paints by Canadian Native Cultures," presented at the *Annual Meeting of the IIC-Canadian Croup*, St. John's, May 1989.

Miller, J., "Analysis of Paints Used by Canadian Native Cultures: A Project at the Canadian Conservation Institute," *Proceedings of Symposium '86: The Care and Preservation of Ethnological Materials*, Ottawa, September 1986., pp. 137-141.

Project summaries published in the *Ethnographic Conservation Newsletter* of the Working Group on Ethnographic Materials of the ICOM Committee for Conservation (June 1985), the *IIC-CG Newsletter* (June 1986), the *Ottawa Archaeologist* (January 1987).

Division: ARL

Number:

Title:	**The Materials and Techniques of Paul-Émile Borduas (1905-1960)**
Purpose:	To analyse samples from selected paintings from the Parisian period of Paul-Émile Borduas.
Dates:	1991-1995 (Project completed)
Team:	Elizabeth A. Moffatt* and David Miller
Description:	The works of this period are typically large black and white oil on canvas paintings. The paint was usually applied with a palette knife, often as thick impasto. Many of the paintings present challenging conservation problems including cleavage, cracking, incomplete drying and exudations. Spectroscopic and chromatographic analysis of samples from eight paintings, dating from 1957 to 1959, was undertaken to investigate Borduas' materials and techniques.
Users:	curators, conservators, scientists, art historians, collectors, and the general public in Canada and internationally.
Links/Partnerships:	This project was initiated at the request of the Centre de conservation du Québec
Results:	Samples were obtained from seven paintings in the collection of the Musée d'art contemporain de Montréal and one in the collection of the National Gallery of Canada. Samples of the paint layers, preparation layers and exudates were analysed by Fourier transform infrared spectroscopy, gas chromatography/mass spectrometry and, when required, scanning electron microscopy/x-ray energy spectrometry, polarized light microscopy and x-ray diffraction. These analyses provided detailed information on the composition of the pigments and binding media. While lead white and ivory black dominated Borduas' palette during this period, there was variability in the composition of both the pigments and the drying oil binding media. The results were evaluated in relation to the problems observed in the paintings.
Publications:	Moffatt, E. A. and D. Miller, "Spectroscopic and Chromatographic Analysis of Selected Paintings from the Parisian Period of Paul-Émile Borduas," *Journal of the International Institute for Conservation—Canadian Group*, vol. 19, 1994, pp. 3-13. Moffatt, E.A. and D. Miller, "Spectroscopic and Chromatographic Analysis of a Suite of Paintings from the Parisian Period of Paul-Émile Borduas," presented at the *IIC- CG Annual Meeting*, Halifax, May 1993.
Division:	ARL
Number:	

Title:	**The Materials and Techniques of Alfred Pellan (1906-1988)**
Purpose:	To analyse the materials and document the techniques used by Alfred Pellan in order to build a database which will assist in devising treatments and selecting appropriate display and storage conditions. The project will provide reference analyses for paintings for which the attribution is uncertain.
Dates:	September 1992 to November 1996 (Project completed)
Team:	Marie-Claude Corbeil,* Elizabeth A. Moffatt, and David Miller
Description:	This project was initiated in conjunction with a major retrospective organized jointly by the Musée du Québec and the Musée d'art contemporain de Montréal. Over 250 samples, mostly paint samples, have been taken from 29 paintings; cross-sections and samples of ground, varnish, and canvas samples were collected as well. Information regarding the execution of the art works was also documented, such as the kind of support used (masonite *versus* canvas, commercially prepared canvas *versus* canvas prepared by the artist), the presence and appearance of signature, etc.
Users:	curators, conservators, scientists, art historians, artists, law enforcement agencies, collectors, and the general public in Canada and internationally.
Links/Partnerships:	This project was initiated at the request of Musée du Québec
Results:	
Publications:	Marie-Claude Corbeil, Elizabeth Moffatt, and David Miller, "A Study of the Materials and Techniques of Alfred Pellan," *CCI Newsletter*, no. 14, September 1994, p. 13-14. Andrée Poulin, "Tout l'art de la chimie de Pellan," *Interface*, vol. 17, March-April 1996, pp. 43-44. Marie-Claude Corbeil, Elizabeth Moffatt, and David Miller, "L'étude des matériaux et des techniques d'Alfred Pellan," 22nd IIC-CG Conference, Montreal, May 1996. (lecture) Marie-Claude Corbeil, Elizabeth A. Moffatt et David Miller, "Les matériaux d'Alfred Pellan," *Journal of the Canadian Association for Conservation*, vol. 22, 1997, pp. 11-30.
Division:	ARL
Number:	

Title:	**The Materials and Techniques of Tom Thomson (1877-1917)**
Purpose:	To analyse the materials and document the techniques used by Tom Thomson in order to build a database which will assist in devising treatments and selecting appropriate display and storage conditions. The project will provide reference analyses for paintings for which the attribution is uncertain.
Dates:	December 1996 to December 2000
Team:	Marie-Claude Corbeil,* Elizabeth A. Moffatt, P. Jane Sirois, and Kristopher Legate
Description:	Several paintings attributed to Thomson offered to Canadian galleries have been examined in our laboratory over the years. Thomson is probably the most copied and imitated Canadian artist and it was recognized that we should build a database of his materials and techniques in order to assist curators. Twenty-two paintings and sketches from the Art Gallery of Ontario collection and eight from the National Gallery of Canada collection were sampled
Users:	curators, conservators, scientists, art historians, artists, law enforcement agencies, collectors, and the general public in Canada and internationally.
Links/Partnerships:	Art Gallery of Ontario; National Gallery of Canada
Results:	The analysis of samples from the Art Gallery of Ontario paintings is complete and an interim report has been sent to the AGO.
Publications:	
Division:	ARL
Number:	

Title:	**Characterization of Silk: Study the Deterioration of Silk Exposed to Fluorescent Lights, Heat/humidity Ageing, Co_2 Fumigation, High Humidity and Dyeing Procedures Using HPSEC, Viscosity and Electrophoresis**
Purpose:	To establish whether HPSEC and SDS-PAGE is able to detect silk deterioration caused by heat, humidity and lower intensity light (UV-free fluorescent light bank). To establish a relationship between silk damage and light intensity. To establish whether acid or alkali treatments affects light stability of silk. The results from this study will establish more analytical techniques for studying silk deterioration, which, in turn will better demonstrate the effect of environment on silk textiles leading to increase freedom in designing treatments, handling and display strategies.
Dates:	1998 - 2000
Team:	Season Tse; Tom Strang
Description:	HPSEC is a novel molecular weight technique first developed at the Hampton Court Palace, by David Howell. The technique is quantitative, quick and not labour intensive. When compare to viscosity, the results from both techniques have excellent correlation. HPSEC, viscosity and electrophoresis will be used to study silk exposed to heat, humidity and carbon dioxide. This will further establish the sensitivity of these methods to changes in silk molecular weight. Secondly, this project will also study silk exposed to UV-attenuated fluorescent lights and xenon-arc at various intensities in order to establish a relationship between silk damage and light intensity. Silk habutae are being exposed to fluorescent light bank for 4, 8, 16, 32, 64 and 96 weeks. The effect of acid and alkaline treatments on light stability of silk will also be investigated.
Users:	Textile conservators and scientists
Links/Partnerships:	Paper and textile research focus group report, 1995 Textile research focus group report Discussions with David Howell (Hampton Court Palace; Surrey, UK) Discussions with Judith Hofenk de Graaff (Central Laboratory for Arts and Science Amsterdam)

Results:

Fluorescent light ageing in progress: silk habutae will be exposed for 4, 8, 16, 32, 48, 64 and 96 weeks.

Silk was aged for 8 weeks at 100°dry oven, 80°C, 65%RH and 80°C, 80%RH

Heat/humidity aged and 4, 8, 16 weeks fluorescent light aged silks were analysed using HPSEC and electrophoresis. The fluorescent light aged silk showed no detectable changes in molecular weight as measured by both HPSEC and SDS-PAGE. The three heat aged silks were very yellow. There were major shifts in chromatograms, indicating a decreased in molecular weight, and loss of 30,000 Dalton band in SDS-PAGE which is also associated with deterioration.

Publications:

Division: CPMR

Number:

Title:	**Characterization of silk: investigate the use of HPSEC (High Performance Size Exclusion Chromatography), viscometry and electrophoresis for assessment of silk degradation**
Purpose:	The development of SEC, viscometry and electrophoresis methods to measure and study silk deterioration. Published analytical procedures for the three methods. Comparison of them based on ageing and treatment results.
Dates:	Completed in February 1999
Team:	Season Tse; Anne-Laurence Dupont (intern)
Description:	This project was designed to evaluate how sensitive HPSEC, viscometry and electrophoresis are for accessing silk deterioration, and how useful they are in studying the effect of treatment processes on silk.
Users:	Textile conservators and scientists
Links/Partnerships:	Development of analytical methods for accessing silk deterioration was identified as a high priority activity by Canadian textile conservators (1986 and 1995 research focus group meetings). Discussions with Judith Hofenk de Graaff (Central Laboratory in Amsterdam), Discussions with David Howell (Hampton Court Palace Textile Conservation unit)
Results:	The results were presented in the National Meeting of the American Chemical Society, Historic Textile and Paper Materials Symposium in Boston, MA, August 1998. A full paper will be published in the symposium proceedings. The same paper was requested for and will be presented at the Textile Specialty Group of the AIC, in June 1999 in St. Louis
Publications:	
Division:	CPMR
Number:	

Title: **Development and Characterization of Laser Cleaning for Materials Conservation**

Purpose:

Dates: 2000 - 2003

Team: Gregory Young, Carole Dignard, Tom Stone, Paul Heinrichs, Leslie Carlyle

Description: Building on earlier trials of laser cleaning on a range of museum materials, the current project is an in-depth study of the photo-thermal, -physical and -chemical effects of laser radiation on materials surfaces. The goal is to contribute to the establishment of guidelines for the proper, safe use of lasers on museum artifacts. The work will focus primarily on natural organic materials but also on selected inorganic materials and metals.

Users: Research sponsors and the conservation field.

Links/Partnerships: Links among the Canadian Conservation Institute, Los Angeles County Museum of Art and the Getty Conservation Institute have been established under the auspices of The National Center for Preservation Technology and Training, United States National Park Service. The partnership is designed to facilitate the exchange of ideas, establish complementary research and provide analytical support and expertise among the three institutions. CCI has also established links with two branches of the National Research Council of Canada: the Integrated Manufacturing Technologies Institute, and the Institute for Chemical Process and Environmental Technology. With these, CCI has access to specialized methods of analysis, various types of lasers and specific expertise in the areas of surface chemistry and laser-induced surface phenomena.

Results:

Publications: Carole Dignard, Paul Heinrichs, Tom Stone and Gregory Young, 'An Overview of Laser Cleaning in Conservation', presentation to the Annual Conference of the Canadian Association for Conservation of Cultural Property, May 1997.

____, 'Overview of Laser Cleaning in Conservation', Poster Session presented at the CAC conference, May 1997, giving preliminary assessment of the NRC tests.

Division: CPMR, T&D

Number:

Title:	**The Development of a Conservation Treatment for Waterlogged Basketry**
Purpose:	To develop a better treatment method for archaeological basketry will be developed. The improved treatment method for waterlogged basketry would yield baskets which have a good appearance and sufficient flexibility for curatorial handling without being tacky.
Dates:	1996 to 2000
Team:	Malcolm Bilz, Tara Grant, Gregory Young, , Charlotte Newton, Cliff Cook, Vera de la Cruz
Description:	Currently used conservation treatment methods for waterlogged basketry tend to result in surfaces that exhibit one of two extremes - either overly dry and fragile or flexible but tacky. We believe that both of these results are due to the difficulty of getting higher molecular weight PEG's (400 and up) to penetrate the secondary cell wall of the basketry materials. In this project, we would try to penetrate the cells walls of basketry materials, beginning with new Western Red Cedar inner bark, with lower molecular weight PEG 200 and diethylene glycol. We will assess the degree of penetration by using the cobalt thiocyanate staining technique. A method which is successful for new basketry material will then be applied to archaeological basketry material.
Users:	Museums dealing with basketry, First Nations groups with basketry, conservators
Links/Partnerships:	Request originated from the UBC Museum of Anthropology
Results:	November 30, 1998 Completed impregnation of Western Red Cedar and Eastern White Cedar inner bark samples with PEG 100, 200, 400 and 3350. Key samples of Western Red Cedar inner bark were stained with Cobalt Thiocyanate and viewed and photographed under a microscope to assess the extent to which the PEG had penetrated the secondary cell walls. It was found that the samples attained a stable weight quickly during impregnation and that PEG 200 does penetrate the cell walls as long as the PEG concentration is up to about 40%. The results of this research were presented at the WOAM conference in October 1998 in Grenoble, France and at the CPMR Archaeological Conservation workshop in November 1998 at CCI.
Publications:	ICOM.CC/WOAM Conference in York, 1996 - Tara Grant presentation. ICOM.CC/WOAM Conference in Grenoble, 1998 - Malcolm Bilz presentation.
Division:	CPMR
Number:	

Title: **Investigations Into the Deterioration of Polyethylene Foam Used for Storage of Museum Objects**

Purpose: To investigate and if necessary to alert Canadian and international conservators and museum personnel to severity of problems related to the deterioration of polyethylene foam, and to give advice on selection of polyethylene foam for long-term museum and conservation applications.

Dates: January 1998 to December 2000

Team: Scott Williams

Description: Several examples of rancid smelling, yellow, brittle, powdery polyethylene foam have been received from Canadian museums, indicating that there may be a problem with this commonly recommended and used material. There is much confused anecdotal information in the conservation literature and especially on the Internet about changes to polyethylene foam manufacturing processes and formulations as a result of banning the use of CFC blowing agents. This project is to address the following questions.

- Are the deteriorated foam samples typical of all polyethylene foam?
- What is the chemical and physical nature and extent of deterioration?
- What brands of polyethylene foam are used in museums, or available commercially?
- Do all brands of polyethylene foam deteriorate the same way?
- Can the brands of the deteriorated foam be identified and differentiated?
- Are some brands of polyethylene foam more resistant to deterioration than others?
- Can the particular chemical composition of the stable brands be identified?
- Does deterioration of polyethylene foams cause damage to nearby objects?
- Do additives affect deterioration of foam and does this vary between brands?

Degraded samples will be chemically analysed. Undegraded samples will be subjected to accelerated aging and analysed.

Users: All conservators and personnel in cultural institutions involved in the storage, display, and transportation of cultural objects: Hundreds of kilograms, even tons, of polyethylene foam are routinely recommended and used in cultural institutions for storage and packing of cultural objects (e.g., CCI Technical Bulletin *Working with Polyethylene Foam and Fluted Plastic Sheet*). All cultural institutions worldwide need to know whether these examples are isolated cases of deterioration, perhaps related to certain brands, or are just the first indications that this material is unstable, which would create a huge problem. If polyethylene foam is unstable and needs to be replaced this could cost the museum community hundreds of thousands of dollars. Furthermore, there is no generally available or acceptable substitute.

Links/Partnerships:

Results: Samples of deteriorated foams have be collected. Some technical and manufacturer's literature has been collected. Discussions have been held with technical representatives of some manufacturers. A message was posted on Conservation DistList and to Conservation On-Line (CoOL) on "Ethafoam and other polyethylene foams in conservation", which noted that a project was beginning on polyethylene foams and CCI was seeking samples and anecdotes. A few were received and these will be incorporated into the research.

Publications: "Ethafoam and other polyethylene foams in conservation" in Conservation On-Line (<http://palimpsest.stanford.edu/byauth/williams/foam.html>), 10 August 1998.

Division: CPMR

Number:

Title: **Investigations Into the Suitability of Polystyrene Products for Use in Storage of Museum Objects**

Purpose: Results will be used to inform Canadian and international conservators and museum personnel about the suitability of polystyrene products, and to give advice on selection of polystyrene products for long-term museum and conservation applications. The Newsletter of the Society for the Preservation of Natural History Collections carried a discussion of polystyrene container suitability several years ago, where it was decided that these were acceptable although there were confusing recommendations about whether to use "food grade" or not. Several requests have been received at CCI about polystyrene insulation foams for painting backings, and polystyrene foams as inner cores in graphic boards like Artcore, Gatorfoam, Bienfang, etc.

Dates: April 1998 to December 2000

Team: Scott Williams

Description: Clear polystyrene vials ("pill-bottles") and boxes with snap-lids and telescoping lids, and polystyrene foams, are commonly used for storage of museum objects, particularly small natural history specimens. Polystyrene products are also used to store photographs, particularly in 35 mm slide mounts and cabinets to house slide and other photographic materials. There is a debate about whether polystyrene containers and foams are safe for museum applications. This project will address the following questions.

- Do polystyrene containers produce hazardous degradation products as they age in museum conditions?
- Do polystyrene containers and foams contain residual styrene monomer?
- Is residual styrene monomer dangerous to stored museum objects?
- Do polystyrene foams contain fire retardants?
- Do fire retardants in polystyrene foams pose any threat to museum objects stored nearby?

Naturally aged and artificially aged samples will be analysed for additives and decomposition products.

Users: All conservators and personnel in cultural institutions who use polystyrene plastic products in conservation and museum applications, particularly in natural history and photograph collections, will benefit from the results.

Links/Partnerships:

Results: Some literature and samples have been accumulated. Several products containing polystyrene foams have been analysed as individual service requests and reported as safe for conservation applications.

Publications:

Division: CPMR

Number:

Title:	**Evaluation of Stain Removal Reagents on Cellulosic Textiles and Paper: Effect of Washing, Deacidification, Peroxide and Borohydride Bleaching, Enzyme and Rust Removal Treatments**
Purpose:	Textile conservators will be able to appropriately apply the research results obtained for paper to cellulosic textiles. CCI will be able to use existing knowledge gained from paper conservation treatment research to develop research necessary for cellulosic textiles.
Dates:	1998-1999
Team:	Season Tse, Jan Vuori, Debra Daly-Hartin
Description:	Washing, deacidification, bleaching and enzyme treatments have been well researched for applications on paper artifacts. A great deal of this research was carried out at CCI. However, many textile conservators have reservations in the direct application of results from paper research because of the differences between the two types of substrates. The results from the deionized water washing projects suggest that textiles are less sensitive to the positive or negative effects of water washing and low concentrations of magnesium sulphate and carbonate. In order to establish this 'link' between paper and cellulosic textiles, this project will review existing literature on deacidification, peroxide and borohydride bleaching, enzyme treatments and the use of commercial rust-removers on cotton and linen textiles. It will also evaluate the effectiveness of these treatments when apply with the ultrasonic mister and suction devices compared to immersion. This project aims to help textile conservators apply these paper conservation treatments to cellulosic textiles. This is an ongoing activity as CCI conservators develop expertise in cleaning and stain removal. Current research will provide information, suggest methods of treatment, evaluate the effectiveness of a reagent and removal methods, and, when necessary, assess possible degrading effects on the substrates.
Users:	Textile, Fine Art and Paper conservators
Links/Partnerships:	1986 Paper and textile research focus group report 1995 Textile research focus group report Discussion with textile conservators: this is a crucial step in order to define what is needed in future cellulosic textile treatment research

Results:

Literature review showed that existing research has already established the beneficial effects of deacidification and borohydride treatments on cotton and linen textiles. Areas that need more work include application of enzymes on textiles, establishing methods to assess removal of borohydride bleach, assessment of the effect of commercial rust-removers such as Rust-go on cellulosic textiles if treatment is done using a suction device. Pre aged cotton and linen test fabrics and stained fabrics were prepared for treatment evaluation.

Different rust-removers were used on the suction table to remove iron stains. Hydrofluoric acid (12%) and oxalic acid were found most effective. However, the effect of short term exposure of old textiles to such strong acids is unknown and will be addressed by current research project. The first study compares the degree of degradation caused by immersion in hydrofluoric (12%), oxalic acids (5%) on cotton, linen, and paper to thiocyanate/EDTA.. Degradation is measured using viscometry and colour.

Publications:

Division:

Number:

Title: **Evaluation of Stain Removal Reagents on Silk: Effect of Water Washing, Dry-cleaning, Deacidification, Peroxide and Borohydride Bleaching, Enzyme Treatments, Detergent Residue and Rust Removers on Silk.**

Purpose: The evaluation of stain removal methods for silk textiles to assess their effect on silk. Information from this project will also contribute to development of the use of suction table, stain removal seminar and publication

Dates: 1998-2001

Team: Season Tse

Description: With the development of HPSEC and viscosity methods for analysing silk, CCI is able to evaluate treatment processes such as wet cleaning, detergent residue, bleaching, enzyme treatments, dry cleaning, on silk. This project will monitor the change in molecular weight distribution and intrinsic viscosity of silk as a function of treatment time and reagent concentration.

Evaluation of rust-removers for silk will be addressed. The difficulty of rust stain removal from textiles has not been addressed satisfactorily, especially if suction table is incorporated in the treatment. The common rust remover for historic materials is dithionite with various chelating agents. The disadvantages in using dithionite prompted the search for an alternative eg. oxalic and hydrofluoric acids are very effective and are used as commercial rust removers. The main concern is the effect of short term exposure of historic textile to such acids. This project will study the effect of oxalic and hydrofluoric acids on silk textiles as a function of time. We will also identify techniques for monitoring treatment chemical residues and evaluating the effectiveness of rinsing procedures.

Users: Textile conservators and collectors

Links/Partnerships: In 1986 Paper and textile research focus group report

1995 Textile research focus group report: the evaluation of stain removal methods for silk textiles is identified as high priority by Canadian textiles conservators.

Results: Silk samples have been aged in the Weather-O-meter at 4 different exposures times and then treated with protease, sodium borohydride, SDS detergent showed that there is no major decrease in molecular weight, as measured by viscometry and HPSEC. There were minor changes in intrinsic viscosity, shifts in chromatograms and intensities of SDS-PAGE protein bands as result of these treatments. These measured changes suggests that while these treatments did not cause major scission to the silk polymer, there may be residual reagents interacting with silk molecules in solution.

Unaged silk habutae have been treated with oxalic and hydrofluoric acids as well as dithionite/EDTA

Publications:

Division: CPMR

Number:

Title:	**Shrink-wrapping Metal (Archaeological Iron)**
Purpose:	To develop a technique that will improve the storage of archaeological metals, especially iron, using a shrink-wrapping technique that would contain dust and metal particulates in storage areas, reduce metal-to-metal contact in storage, and allow more effective use of storage areas.
Dates:	February 1998 to 2000
Team:	Judy Logan, Malcolm Bilz
Description:	Iron is often found in quantity on archaeology sites. Objects are usually covered with a layer of corrosion and dirt, and very often go into storage without treatment to remove soluble salts and other agents that will cause corrosion. Even if contained in plastic bags, iron generates metal-containing dust that causes staining and catalyses other mechanisms of degradation in adjacent materials. We are going to investigate the practicality of vacuum shrink-wrapping collections of archaeological iron. In a shrink-wrapped envelope, iron objects can be examined, x-rayed, and stored in compact storage. Dust levels should be reduced and if the objects develop active corrosion, they will be held together within the envelope. Should the object be required for analysis, or display, or a conservation treatment, the plastic wrap can be removed. We will be investigating the optimum type of wrap, as well as the systems presently on the market for vacuum shrink-wrapping. We will also be contacting colleagues at the National Museum of Denmark where they have done some work in this area.
Users:	Organizations that curate archaeological collections.
Links/Partnerships:	
Results:	
Publications:	
Division:	CPMR
Number:	

Title: **Microscopic Spot Tests to Distinguish Bakelite (Phenol-formaldehyde) From Ebonite (Vulcanite, Hard Rubber)**

Purpose: A spot test will be developed and described in a CCI Note, which will provide a new tool for conservators to enable them to identify and distinguish Bakelite and Ebonite, and to identify Ebonite materials that might cause corrosion of metallic components of composite objects or be damaged by harmful wet cleaning treatments.

Dates: January 1996 to December 2000

Team: Scott Williams

Description: Conservators and curators note that Bakelite and Ebonite are difficult to distinguish when new or undegraded, being generally opaque, relatively glossy, hard black or very dark brown plastics. Both materials occur in early radio and other electrical apparatus, sometimes together in the same object. Distinction is important because Ebonite, with its high sulfur content, produces sulfuric acid as it degrades, which corrodes metals, whereas Bakelite does not appear to cause damage as it ages. Also, these materials respond very differently to common wet cleaning treatments with water, surface active agents, and alcohol solutions.

A procedure will be developed to use microscopic spot tests to distinguish Bakelite from Ebonite based on adaptations of known macroscopic spot tests for formaldehyde (the Chromotropic acid test) and phenol (the Gibbs indophenol test) from Bakelite, and the iodine-azide test for reducible sulfur from Ebonite. The main thrust of the project is to adapt the macroscopic tests for use on curatorially acceptable small microscopic samples from objects.

Users: Conservators and museums who have, or treat, objects made of Bakelite or Ebonite, especially science and technology museums with early electric and radio equipment, will benefit from procedures developed from this research.

Links/Partnerships: This project was developed as a result of discussions which took place at a number of meetings - in particular the Symposium '91 "Saving the 20th Century" - where it was explained that the main problem faced by museums having collections of plastics was lack of identification or confusion about material attribution

Results: Macroscopic tests for sulfur in Ebonite (iodine-azide test) and formaldehyde in Bakelite (the Chromotropic acid test) have been miniaturized for application to curatorially acceptable microscopic samples from objects. Lab work continues on miniaturization of the Gibbs indophenol test for phenol in Bakelite, and to sort out a few interferences with the tests. A CCI Note has been drafted.

Publications:

Division: CPMR

Number:

Title: **Comparison of PEG and Glycerol for the Treatment of Archaeological Leather**

Purpose: To assess the two treatments on a variety of new and archaeological samples. To be able to make predictions about the stability of leather treated by each method. It is anticipated that, through the scientific study of the two treatments (PEG and glycerol) on a variety of new and archaeological samples, we will better be able to assess the appropriate application of each treatment. We should be able to make predictions about the stability of leather treated by each method

Dates: 1998 - 2000

Team: Charlotte Newton, Cliff Cook, Greg Young, Malcolm Bilz, Season Tse, Tara Grant.

Description: Old and new leather and skin samples have been immersed in aqueous solutions of polyethylene glycol (PEG) or glycerol. Analysis of these treated samples by thermal microscopy, differential scanning calorimetry and thermal Fourier transform infrared micro spectroscopy is being done to characterize the interactions between fibrous collagen and either PEG or glycerol to determine which of these two humectants provides greater stability to the leather.

Polyethylene glycol and glycerol are, at present, the most common materials used in the treatment of wet archaeological skin and leather. Both have been used over a period of years, but there is disagreement over the effectiveness and long term stability of the treatments, and the nature of their interaction with the leather. Thus far, assessments of the methods have been based on such characteristics as appearance, flexibility, shrinkage, colour change and friability. Little work has been done to assess, by analytical methods, how each material interacts with the leather substrate and how the characteristics of each conservation material will affect the long term stability of the leather. This is an important question and one of current interest, since a large number of artifacts are regularly treated by these methods. There are also a great many treated objects in collections, and with more knowledge we will be able to anticipate problems in the future.

Users: Leather and skin are found in quantity on a variety of archaeological sites (wet, dry, frozen) in Canada and around the world. PEG and glycerol are the two most common treatment methods at present and as a result a large number of artifacts are treated using these methods. This work will be of benefit to conservators who treat archaeological leather, since it will provide a scientific assessment of the effect of each treatment, and as a result will help us to make a more informed choice of treatment. It will also benefit those who care for collections which include treated leather artifacts by providing information about future stability, the possible need for special storage conditions or eventual re-treatment.

Links/Partnerships: This is a subject of interest to conservators in and outside Canada, and has been raised at WOAM meetings. The interaction of glycerol and collagen, and the post treatment behaviour of glycerol are listed as research topics of interest to members of the Archaeological Leather Group (UK).

Results:

Publications:

Division: CPMR

Number:

Title: **Characterization and Long-term Stability of Artifacts *in situ* and in Reburial Conditions**

Purpose: To develop expertise in the subject of the monitoring of historic and/or archaeological sites in order to provide better information to our clients. To identify and develop better tools for site management which will permit better detection of environmental change and its effect on artifacts, cultural resources or sites.

Dates: 1998 to 2001

Team: Nancy Binnie, Judy Logan, Tara Grant, Charlotte Newton, Cliff Cook, Malcolm Bilz

Description: Expertise is being developed in the field of monitoring of *in situ* submerged and terrestrial archaeological sites in order to identify and develop better tools for site management. Monitoring information can be used by site managers to characterize sites, estimate deterioration rates, as well as to detect environmental changes which can de-stabilize artifacts.

The focus for this project will be on underwater or waterlogged sites (reflecting the demand shown by client enquiries), however burial and reburial sites for human remains and archaeological artifacts will also be considered.

Users: Department of Canadian Heritage agencies responsible for the monitoring of cultural resources (land based and submerged), municipal/provincial governments, provincial cultural agencies, archaeological developers, site managers, persons responsible for cultural management programs including first nations sites, law enforcement agencies, and potential international clients

Links/Partnerships:

Results:

Publications:

Division: CPMR

Number:

Title: **Archaeological Iron Treatments**

Purpose: To evaluate and assess the effectiveness of chemical treatments (sodium hydroxide and ethylenediamine in particular) for archaeological iron and to promote a greater awareness of a systematic and scientific approach to studying such chemical treatments.

Dates: 1998-2002

Team: L. Selwyn

Description: In the early 1980's, a treatment for archaeological iron was developed at CCI, but the chemistry was never fully understood and a full description of the treatment was not published. Between 1994 and 1996, during a fellowship at CCI, Dr. V. Argyropoulos made progress in understanding the chemistry by comparing treatments using solutions of sodium hydroxide and ethylenediamine and developing a systematic approach to studying iron treatments. Continued work on this project will involve writing manuscripts to publish her results and to promote the research being done at CCI on archaeological iron.

Users: Canadian and International archaeological conservation community.

Links/Partnerships:

Results: Vasilike Argyropoulos completed her fellowship in 1996. She studied many aspects of archaeological iron treatments and the results from this work will be published in several papers. The tentative titles are:

"Chloride and Iron Removal from Archaeological Wrought Iron with Sodium Hydroxide and Ethylenediamine" by L. Selwyn and V. Argyropoulos. This paper will contain the results from an evaluation of 34 artifacts from Newfoundland, treated with either sodium hydroxide or ethylenediamine. This manuscript will involve the interpretation of chloride ion results. Other aspects are the use of ethylenediamine and sodium hydroxide as corrosion inhibitors, and how ethylenediamine works as a chelating (complexing) agent.

"Neutron Activation Analysis (NAA) of Chloride Levels in Archaeological Iron Before and After Treatment" by L. Selwyn and V. Argyropoulos. This paper will contain preliminary results on NAA analysis of a selected number of nails. More experimental data may be needed to complete this work.

"Potentiodynamic Polarization and Corrosion Potential Measurements of Archaeological Iron in Ethylenediamine" by L. Selwyn and V. Argyropoulos. This paper will contain results of measurements carried out at CCI and at CANMET in Ottawa. More measurements may be needed.

In May, 1999, L. Selwyn presented a lecture at the CAC conference in Winnipeg on "Active Corrosion on Archaeological Iron" to promote this research to the Canadian conservation audience.

Publications:

In May, 1998, L. Selwyn prepared a poster "Active Corrosion on Archaeological Iron" and gave a presentation on the poster at ICOM Metal 98 in France. This poster has been turned into a brochure containing colour photographs and is available through CCI publications.

In December, 1998 a manuscript coauthored by L. Selwyn and M. McNeil (at the U.S. Nuclear Regulatory Commission in the USA) on "Electrochemical Processes in Metallic Corrosion" was submitted for a book chapter in *Handbook of Archaeological Sciences* to be published by Wiley.

In March 1999, L. Selwyn completed a manuscript "Analysis of the Chloride Ion Concentration in Aqueous Treatment Solutions by Potentiometric Titration" as a possible CCI publication. It contains details on the quantitative chloride ion analysis using by V. Argyropoulos in her research and will be referred to in the above publications. The manuscript was peer-reviewed within CCI and finished as CPMR 836, Proteus 68874.

In October, 1999, a paper by L. Selwyn on "Corrosion of Archaeological Iron Before and After Excavation" was published in the proceedings of the 1999 NACE (National Association of Corrosion Engineers) Northern Area Eastern Conference, Ottawa, October 24-27 1999, paper no. 2B.1, pps 1-8. It was submitted in June, 1999.

In Dec 1999, the paper "The Corrosion of Excavated Archaeological Iron with Details on Weeping and Akaganéite" by L.S. Selwyn, P.J. Sirois, and V. Argyropoulos was published in *Studies in Conservation*, vol 44 (1999) pg 217-232. It was submitted in July, 1998.

Division: CPMR

Number:

Title: **Effect of Deionized Water Washing on Cellulosic Textiles**

Purpose: The results from this and other paper washing studies will be used to develop guidelines for paper and textile conservators who carry out deionized water washing and deacidification. The information will also be useful for establishing the requirements of purification systems for paper and textile conservation labs.

Dates: 1992 - 1999

Team: Season Tse.

Description: Wet cleaning of historic textiles was identified as high priority during the 1995 textile research focus group meetings. The question of water quality and addition of salts to wash water was a main issue in wet-cleaning. Six naturally aged cotton and linen textiles, along with cotton and linen text fabrics were washed in deionized water (18 mega-ohm), some were immersed in magnesium sulphate (20 ppm) and some in magnesium bicarbonate (20 ppm) after washing. The treated textiles and the untreated controls were artificially aged at 80°C, 50% RH for 8 weeks. The degree of degradation were measured using viscometric degree of polymerization in a cadoxen solvent before and after ageing. The inorganic content (Mg, Ca, Na, K, Fe) of unaged treated textiles were also analysed using flame atomic absorption analysis.

The experimental portion of this project was completed. The results from this study together with data from other paper washing studies will be used to prepare guidelines which will address the following issues:

Wash water quality - is pure (DI) water bad for washing cellulosics?

Does adding low concentrations of magnesium salts (alkaline water) benefit paper and textiles? How to determine the concentration of deacidification compounds in solutions - calculations?

How long do you need to wash in order to remove the most acid?

Wash water monitoring - what is in wash water?

Long term effect of wet cleaning on textiles

Effect of washing: A comparison between paper and textiles.

Users: Paper and textile conservators.

Links/Partnerships: 1986 Paper and textile research focus group report

1994 Paper research focus group report

1995 Textile research focus group report,

Discussions with Metropolitan Museum of Art -Textile Conservation Laboratory, NY,

Discussions with Sherry Guild, Jan Vuori, conservators at CCI,

Queen's MAC program- lecture requests

Results: DP analyses of all the samples and AA analyses of treated and unaged samples were completed. The data have been compiled and a draft publication is being prepared.

Publications:

Division: CPMR

Number:

Title: **Awareness of Lead in Conservation**

Purpose: To make conservators aware of the wide-ranging uses of lead in conservation and to warn conservators about the potential hazards of dealing with lead in artifacts. To advise conservators on how to identify lead using qualitative spot tests and to give them information on where to obtain services for quantitative identification of lead levels

Dates: 1997 - 2002

Team: L. Selwyn

Description: This project is intended to warn conservators about the hazards of lead and to offer advice on identifying and dealing with lead artifacts, and maintaining a safe working environment. The information collected during this project will be published as a comprehensive review containing a survey of lead and lead compounds, with possible sources of lead and lead compounds in artifacts and historic buildings listed. It may also be made available as a CCI Note.

Users: All conservator, curators, restorers, general public, collections researchers, interpreters.

Links/Partnerships:

Results: The literature survey has been completed and the information has been organized into the following areas:

(a) the corrosion processes of lead indoors, outdoors, and during burial

(b) the corrosion products identified on lead objects from the above environments

© The active corrosion of lead caused by acid vapours and forming loose, powdery corrosion

(d) the health hazards associated with lead exposure

(e) the safety precautions to follow when dealing with lead and lead corrosion

(f) the kinds of artifacts where lead is encountered (e.g., sculptures, paint in historic houses, stained glass, artist's pigments, textiles, roofing material, solder, etc)

(g) varius methods for identifying metallic lead (e.g., chemical spot tests, portable XRF)

Publications:

Division: CPMR

Number:

Title:	**A Better Bag for Artifact Storage**
Purpose:	To develop a bag that would be ideal for use on archaeological excavations, and which may also have other applications in museum or archival collections.
Dates:	February 1998 to 2000
Team:	Judy Logan, Malcolm Bilz
Description:	Artifacts should be stored in enclosures which are chemically stable and allow for air exchange. Ideally, the material an enclosure is made of should be able to have labels adhered in order to identify the contents. The enclosure should also allow the artifact to be viewed and be easy to open and close. For many types of artifacts, especially archaeological materials which are often dirty, polyethylene bags are the most practical type of container. The disadvantages of polyethylene bags are that they do not breathe and that printing and labels do not adhere well. We are going to look into the possibility of having bags manufactured that are made of Tyvek and clear polyethylene. The Tyvek will allow for air exchange and is easily labelled. Tyvek is spun polyethylene, and will heat seal to clear polyethylene. Various closure systems are possible (zip-locks, heat-sealed wire, folded tops). If such a bag could be manufactured and sold at a price comparable to standard polyethylene bags, they would be ideal for numerous uses in museums, on archaeological sites, and in disaster recoveries.
Users:	Archaeologists, collection managers, archivists, conservators
Links/Partnerships:	
Results:	Several prototypes have been made
Publications:	
Division:	CPMR
Number:	

Title:	**The Critical Evaluation of Methods Used for Monitoring the Degradation (ageing) of Paper**
Purpose:	The purpose of this project is to use statistical analysis to determine which methods are the most useful (sensitive, precise, accurate) for describing chemical and physical changes in different kinds of papers due to ageing (natural or accelerated).
Dates:	1999-2000
Team:	Elzbieta Kaminska
Description:	Results from the mass deacidification and permanent paper projects can be used for this purpose. Over 20 different tests were used to estimate the degradation of different kinds of new and naturally aged papers after different treatments and/or accelerated ageing.
Users:	The benefit is mostly for paper researchers but conservators and the paper industry could also find this kind of information useful.
Links/Partnerships:	
Results:	
Publications:	
Division:	CPMR
Number:	

Title: **The Effect of Modifiers on the Stability of A Vinyl Acetate/Ethylene (VAE) Copolymer Emulsion Adhesive.**

Purpose: To identify modifiers that do not adversely affect the stability of a VAE adhesive so that a good conservation adhesive can be formulated by the conservators themselves, tailored to their needs.

Dates: 1994 to 2002

Team: Jane Down

Description: To identify modifiers that do not adversely affect the stability of a VAE adhesive so that a good conservation adhesive can be formulated. Eighteen common modifiers were added to a well characterized VAE emulsion in known concentrations and samples were subjected to dark and light aging for about 5 years. Yellowing, pH, flexibility, cohesive strength, gloss and removability were monitored for significant changes upon aging. Proposed activity for 1999: Write up preliminary report and make it available to the conservation community. In 1999, the 4th year measurements for pH, gloss and yellowing are scheduled.

Users: All conservators.

Links/Partnerships:

Results: The VAE selected for testing was Dur-O-Set E-150 which did not contain any additives except those added for polymerization and emulsion stabilization. The modifiers selected for testing were plasticisers dibutyl phthalate, ditridecyl phthalate, and polyethylene glycol dibenzoate, solvents toluene, methanol and diacetone alcohol, wetting agents anionic di-(2-ethylhexyl) sulphosuccinate and non-ionic acetylenic glycol, thickeners methyl cellulose, wheat starch, fumed silica, polyethylene oxide, and a neutral acrylic acid salt, fillers calcium carbonate, talc and china clay, freeze-thaw stabilizer ethylene glycol and humectant glycerin. Initial testing of the prepared films of VAE containing the modifiers began in 1995 for pH, yellowing, and gloss. Flexibility, strength, and removability testing began in 1996. Measurements on all samples were taken each year until 1998. In February of 1998, the data from the first two years was assessed. Since in most cases differences between modifier films and aging conditions were not dramatic, it was decided to skip the third year of testing in order to lengthen the aging period as much as possible. In 1998, the 1st year measurements on the pH and swelling of the combination modifiers, and the 2 year measurements for stress/strain were performed. The results for the first two years has been written up in a report which is now available from CCI. Aging and monitoring of results continues.

Publications: J.L. Down, "Adhesive Projects at the Canadian Conservation Institute", In Resins Ancient and Modern, Pre-prints of the SSCR's 2nd Resins Conference, Aberdeen, Scotland 13-14 September 1995, pp.4-12.

J.L. Down, "Towards a Better Emulsion Adhesive - A Preliminary Report on the Effect of modifiers on the Stability of a Vinyl Acetate/Ethylene Copolymer Emulsion Adhesive", Technical Report No. 1, CCI, 1999. Available from CCI for $10 Cdn plus shipping.

Division: CPMR

Number:

Title:	**The Disaster Recovery of Modern Machine-Readable Information Carriers**
Purpose:	It is anticipated that the results from this research project can be developed into a procedure for the disaster recovery of modern information carriers. Research on modern records is a priority for the Canadian Council of Archives. In addition, at the recent CAC workshop on digital media, CCI was called upon by a representative of the National Archives (Jacques Grimard) to lead the effort for work in this field in Canada.
Dates:	1999-2000
Team:	Joe Iraci
Description:	The collecting of information carriers such as magnetic tapes and optical discs by archives, libraries, and other institutions is growing every year. Consequently, the need for information on how to deal with these materials in light of the fundamental differences that exist with traditional information carriers such as paper, photographs, etc., is also growing. Individuals responsible for preserving these records do not have the information that they need to make practical preservation decisions. One of the areas where more information is required is the behaviour of these materials in a disaster situation. The Canadian Council of Archives (CCA) has acknowledged this need and has decided to provide some funds to CCI in order to perform research on the disaster recovery of modern machine-readable information carriers. The project will examine optical discs, magnetic disks, and magnetic tapes and is divided into four phases: a) Preliminary testing, b) Soaking experiments, c) Investigation of drying techniques, d) Investigation of cleaning techniques.
Users:	Any organization that may have modern records that store information such as archives, libraries, museums, galleries, government departments, private sector companies, etc.
Links/Partnerships:	This project was conducted at the suggestion of the Canadian Council of Archives.
Results:	The testing of optical discs and magnetic disks has been completed and a report has been written. The next phase is to perform work on magnetic tapes.
Publications:	The Canadian Council of Archives (CCA) is interested in having CCI write a bulletin that would summarize for lay audiences in smaller archival institutions the current state of knowledge on deterioration problems of modern media, longevity, and storage and handling requirements
Division:	CPMR
Number:	

Title:	**An Investigation into the Accelerated Ageing of Paper -- Research Towards the Development of a New Permanency Standard**
Purpose:	The development of accepted test methods for paper stability. This will enable the development of standards for permanent paper to be based on performance rather than on composition.
Dates:	1998 - 2000
Team:	Paul Bégin, Elzbieta Kaminska, David Grattan, Joe Iraci, Donna Woods, and Anna Bülow
Description:	This is part of a US based international project coordinated through an ASTM sub - committee to develop new performance standards for permanent paper. The purpose of this project is to develop new testing techniques to be used in permanent paper standards. This is a joint project and CCI's role is to examine the thermal accelerated aging of paper.
Users:	Members of the ASTM sub-committee Paper manufacturers, Archives and libraries.
Links/Partnerships:	Image Permanence Institute, The US Forest Product Laboratory, US Library of Congress, KCL Laboratory (Finland)
Results:	This work examined the stability of two kinds of acidic wood-pulp papers aged in single sheet and stack form at elevated temperatures. These Arrhenius type aging experiments were conducted under conditions retaining the initial moisture content of the paper upon its transfer from ambient (23°C, 50% RH) to accelerated aging conditions. CCI's part of the study is completed and a draft final report has been prepared and submitted to ASTM. Scientists at the US Library of Congress are also working on the thermal aging of paper with an emphasis on the identification of degradation products. Once they have completed their draft final report, a joint CCI/LC accelerated aging test protocol will be proposed in the spring of 2000. Testing of the test protocol will follow.
Publications:	Kaminska, E., Bégin, P., Grattan, D., Woods, D., and Bülow, A., "ASTM/ISR Research Program on the Effects of Aging on Printing and Writing Papers: Accelerated Aging Test Method Development," Draft Final Report to the ASTM Advisory Committee on Paper Aging Research, Nov. 1999.
Division:	CPMR
Number:	

Title:	**The Development of a Canadian Permanent Paper Standard**
Purpose:	To develop a Canadian Permanent Paper Standard that will increase the proportion of published material on permanent materials and will have a substantial long term benefit on the preservation of written heritage.
Dates:	1996 - 2000
Team:	Paul Bégin, David Grattan, and Joe Iraci
Description:	To participate in the preparation of a draft Permanent Paper Standard to be adopted as the Canadian General Standards board (CGSB) standard.
Users:	The Sponsors group, Archives, libraries and anyone who requires the use of permanent paper.
Links/Partnerships:	The Pulp and Paper Research Institute of Canada (Paprican).
Results:	An extensive research project (Canadian Co-operative Permanent Paper Research Project) conducted at the request of the National Library and National Archives of Canada and overseen by the CGSB Sub-committee on Paper Permanence, provided valuable information regarding the impact of lignin and air pollutants on the stability of paper. This information was then used to assist in the drafting of a Canadian Permanent Paper Standard. The draft standard has undergone many revisions but is now in it's final stages and should be adopted by the committee by the spring of 2000.
Publications:	Zou, X. et al., Bégin, P. et al., "Canadian Co-operative Permanent Paper Research Project: The Impact of Lignin on Paper Permanence," *Final Report*, January 1998; Pulp and Paper Research Institute of Canada/Canadian Conservation Institute. Bégin, P., Deschâtelets, S., Grattan, D., Gurnagul, N., Iraci, J., Kaminska, E., Woods, D. and Zou, X., "The Impact of Lignin on Paper Permanence: A Comprehensive Study of the Aging Behaviour of Handsheets and Commercial Paper Samples," *Restaurator*, Vol 19, 1998, pp. 135-154. Bégin, P., Deschâtelets, S., Grattan, D., Gurnagul, N., Iraci, J., Kaminska, E., Woods, D. and Zou, X., "The Effect of Air Pollutants on Paper Stability," *Restaurator*, Vol 20, 1999, pp. 1-21.
Division:	CPMR
Number:	

Title: **Assessment of the Effect of Light and Dark on the Yellowing of Oil Paint**

Purpose: To determine if old oil paint still responds to dark/light cycles, - if so this will have a direct impact on the policies for treating paintings which have recently been removed from dark storage.

Dates: November 1999 to December 1999

Team: Leslie Carlyle, Nancy Binnie, Anne Ruggles (NGC), Ewa Bjordell (curriculum intern, Sweden), Maureen Macdonald

Description: Two nineteenth-century oil paintings from the National Gallery of Canada will be monitored to determine their sensitivity to light after a prolonged period of storage in the dark. Relatively young lead white oil films were previously shown to be highly responsive to change after exposure to cycles of light and dark: in the dark, the paint grew measurably yellow, then lost yellow in the light. Monitoring of the response of paint which is fully matured (over 100 years old) was necessary to determine whether old paint is still responsive to light in this manner. Monitoring was carried out using a Minolta CR300 tristimulus Chromameter. The two NGC paintings were measured while in storage, then transported to CCI where they were exposed to continuous moderate light for 6 months followed by 6 months in the dark. Light levels, UV, and changes in L*, a* and b* values were measured.

Users: CCI, The National Gallery of Canada, Canadian and International Conservators, Curators, Conservation Scientists

Links/Partnerships: Anne Ruggles, National Gallery of Canada.

Results: Ten locations (five on each painting) were selected for colour-monitoring. Chromameter measurements were taken initially at 15 minute intervals, and later at two-week intervals during light-exposure for a total exposure time of 168 days. These measurements were continued at monthly intervals during 182 of dark storage (all light was eliminated during dark storage). Nancy Binnie has compiled all data from the readings in charts and tables (CCI Report No. 70925 December 22, 1999).

Both paintings exhibited significant loss of yellow during light exposure (bleaching), and some increase in lightness. Most of the changes occurred during the first 50 to 100 days, with the amount of change and the rate of change being different for each painting. Upon subsequent dark storage, the two paintings slowly increased in yellowness, but after a total of 182 days in the dark, the colour at each location of measurement had not yet returned to the degree of yellowness initially measured.

Publications: A paper detailing these results will be submitted to a refereed conservation journal.

Division: CPMR

Number:

Title:	**Flour Paste Ground Project**
Purpose:	This project will contribute to an International project - The Biaxial Tensile Behaviour of Paintings which will involve mapping of the strain on model paintings to assist in understanding the interactive processes that occur. It will also be used in the creation of representative cross-sections of flour-paste grounds for comparison with the use of these materials in actual paintings. In addition this project will further the understanding of creating reconstructions of old recipes, helping to determine what is important when considering the materials to use and their preparation.
Dates:	October 1998 to April 1999.
Team:	Leslie Carlyle, Christina Young (University of London/Tate Gallery),Ewa Bjordell (curriculum intern, Sweden)
Description:	To date, research on the behaviour of canvas paintings (Mecklenburg, Berger & Hedley) has largely concentrated on grounds prepared with animal glue size, and oil paint grounds. The Biaxial Tensile Behaviour of Paintings Project will conduct mapping of the strain on model paintings to assist in understanding the interactive processes that occur (see *Studies in Conservation*, Vol. 44, No.2, 1999). By providing flour-paste grounds, their particular properties can be assessed to compare and contrast their behaviour from the glue-sized/oil grounds. It is anticipated that this testing will also reveal differences in materials and preparations methods within the flour-paste grounds, and within variables which will be introduced during their preparation (e.g. the use of commercial bone meal vis a vis bone meal from sheep' trotters).Three nineteenth-century flour-paste ground recipes were prepared using methods and materials consistent with the period in which the recipes were initially published (1806, 1849, 1850s). Three sets of each ground were applied to canvas pre-washed and stretched onto 12 inch (30.5 x 30.5 cm) stretchers. The prepared grounds were shipped to England where they will be used in the research project "Biaxial tensile behaviour of paintings on canvas" which is currently being undertaken by Dr. Christina Young. A set of each of the grounds was applied to 10 inch stretchers (25.4 cm x 25.4 cm) and small artist's boards.
Users:	CCI, The Biaxial Tensile Behaviour of Paintings Project, paintings conservators nationally and internationally who stand to learn more about the behaviour of paintings and painting materials.
Links/Partnerships:	Dr. Christina Young in conjunction with The Tate Gallery, The National Gallery, London, The Courtauld Institute of Art, and Imperial College, University of London, U.K.
Results:	March 1999: All three flour-paste grounds and variants have been applied to the canvases which consist of a total of 15 twelve-inch stretchers, and 24 ten-inch stretchers. The packing case for shipping was designed in consultation with Paul Marcon and Bob McRae and sent to the Tate in the spring of 1999.
Publications:	A paper will be written with Dr. Young and submitted to a refereed conservation journal.

Division: CPMR

Number:

Title:	**Oil Processing Project: Reconstructions of Historical Oil Processing and Oil Paint**
Purpose:	To investigate specific recipes for preparing artists' drying oils to determine how such processing influences the resulting paint.
Dates:	March 29th to December, 1999, with project assessment continuing into 2000.
Team:	Leslie Carlyle
Description:	To investigate the relationship between various methods to clarify and process artists' oils prior to making oil paint and the oil paint which results. Three different paint driers, and a number of paint medium modifiers will be studied as well. The chemical interaction between the oil treatment and the different paint driers will be investigated. Initial observations on changes in paint rheology and colour will also be monitored during the paint making and application procedures. Film-forming defects will be monitored as the paint dries to determine whether such defects can be related to defects in extant oil paintings. It is hoped that this work will also contribute to an understanding of the mechanism by which inclusions in the paint found in early paintings such as Rembrandt's *Anatomy Lesson of Dr. Tulp*, and those seen in 19th century paintings develop. Understanding such phenomenon will be extremely significant to the interpretation of painting technique nationally and internationally.
Users:	Conservators, Conservation Scientists, Curators and Art Historians, Nationally and Internationally
Links/Partnerships:	Molart, FOM Institute Amsterdam
Results:	Between September and December 1999, oil was pressed from Linseeds, and processed for paint preparation, and paint samples were prepared as part of a Molart fellowship at the FOM Institute for Atomic and Molecular Physics in Amsterdam. A selection of samples will be studied by researchers associated with the Molart program, and the rest of the samples have been sent back to CCI for further study.
Publications:	A joint publication with Molart researchers is planned.
Division:	CPMR
Number:	

Title:	**Cracking and Inclusions in Drying Oils on Paintings**
Purpose:	This research should answer questions on the relationship between materials processing and film-forming defects in extant oil paintings. The mechanism by which inclusions in the paint found in early paintings such as Rembrandt's *Anatomy Lesson of Dr. Tulp*, and those seen in 19th century paintings will be elucidated, and current theories on the mechanism of their formation verified. Understanding the phenomenon of drying cracking and inclusions will be extremely significant to the interpretation of painting technique nationally and internationally.
Dates:	March 29th to December, 1999
Team:	Leslie Carlyle
Description:	To investigate specific recipes for preparing artists' drying oils to determine whether such processing can result in film-forming defects (eg. drying cracks), and precipitates (eg. tiny egg-shaped inclusions).
Users:	
Links/Partnerships:	Molart, FOM Institute Amsterdam.
Results:	In March 1999 a series of meetings in Amsterdam have established that the fellowship will run between September and December 1999 for a period of three months, that expertise is available from ICN for some preliminary documentary research (Hayo de Boer and Ad Stijnman), and that the equipment for pressing linseed oil and for handgrinding paint samples will be available along with a room at the FOM institute. Dutch process lead-white will be supplied by Molart. In the period April to August 1999, a thorough literature search will be necessary to find representative recipes for manufacturing sulphuric acid, and for oil refining, substrates for the project will need to be prepared, and the project design fully worked out. Literature searches will be conducted both at CCI and at ICN.
Publications:	
Division:	CPMR
Number:	

Title:	**The Establishment of Environmental Standards for Museums, Libraries and Archives**
Purpose:	To establish clearly reasoned and rational standards for use in setting temperature and relative humidity guidelines for various types of collections housed in buildings of varying capabilities, and to have these integrated into the recommendations of a recognized standards organization
Dates:	January 1996 to summer 1999
Team:	Stefan Michalski*
Description:	CCI has been advocating museum norms of temperature and relative humidity since 1978, but over the past 10 years has been looking more closely at the rationale behind these standards, and the cost of achieving them. The actual conditions that are possible and desirable within a given facility are a compromise between the needs of the collection, the capabilities of the building and building envelope, and the amount of money and expertise available to install and operate an HVAC (heating, ventilation and air conditioning) system. Traditionally, the reliability of an HVAC system or the capability of an institution to maintain a system have not been sufficiently considered. In 1997 and 1998, CCI worked with the Canadian Council of Archives to create a document entitled *Environmental Guidelines for Canadian Archives*. In 1998, a paper on climate control for collections housed in historic buildings was published. And through 1997 and 1998, CCI has participated in a working group which is writing a chapter on "Museums, Libraries and Archives" for the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE). ASHRAE publications are used by architects and engineers throughout North America when designing facilities, and the publication of a comprehensive yet concise chapter which outlines issues, challenges, and potential solutions, has the potential to improve the needs and functionality of museum, archive and library buildings.
Users:	Architects, engineers, conservators, and facilities mangers who are involved with the construction or retrofit of museum, archive and library buildings in North America.
Links/Partnerships:	ASHRAE Committee writing the new chapter "Museums, Libraries and Archives" for the ASHRAE Applications Handbook; Canadian Council of Archives Preservation Committee
Results:	Three publications completed and currently in press or in the process of being assessed for approval by a standards committee.

Publications: Stefan Michalski, contributing author to "Museums, Libraries and Archives" ASHRAE Applications Handbook (American Society of Heating, Refrigeration and Air-conditioning Engineers), pp.20.1 - 20.13; in press (due May 1999)

Michalski, Stefan, "Environmental Guidelines for Canadian Archives", Canadian Council of Archives and the Canadian Conservation Institute, in press.

Michalski, Stefan, "Climate Control Priorities and Solutions for Collections in Historic Buildings", Historic Preservation Forum, 12, no. 4, summer 1998, pp.8-14

Division: PCS

Number:

Title: **Development of a Museum Survey Tool and Protocol**

Purpose: To develop a survey tool which will guide an experienced conservator to carry out an evaluation of an institution and its collection, capture their observations, summarize their recommendations, establish priorities, and generate a report, all in a reproducible manner. To allow the data from a series of surveys to be compiled and analysed to identify trends and overall priorities.

Dates: January 1996 to March 2001

Team: Stefan Michalski,* Siegfried Rempel

Description: Museum surveys are carried out on an ongoing basis, evaluating either the museum facility or the collection, or both. While these surveys can provide valuable information to the client, the results of different surveys are frequently difficult to compare. This problem becomes even more acute if a series of museums or sites are to be surveyed over a period of time, and the client wants to be able to assess the overall priorities of the sites a whole, and identify trends within this series.

The survey tool that has been developed is a relational database using Microsoft Access. The database guides the conservator to make observations first of all about the site, about the exterior of the facility, then about the interior (room by room), about the fittings within each room (display cases or storage cabinets or shelving) and finally about the condition of the collection within each fitting. Observations are entered into the database during the surveying period, and photographs are taken to document specific recommendations, and are also captured in the database. Summary recommendations are written following the survey, and priorities are assigned based on an established hierarchy. The report is then automatically generated from the database. A number of museums may be surveyed as part of one database file, and then overall trends or priorities can easily be identified.

Users: Museum directors, administrators, conservators, and other decision makers in Canada and abroad who want to establish priorities, especially those who have responsibilities for a number of museums or sites.

Links/Partnerships: This tool has been developed and refined while carrying out surveys of Canadian Forces Museums across Canada, through the Directorate History and Heritage of the Department of National Defence.

Results: Over 40 Canadian Forces museums have been surveyed to date using this protocol. Reports for the 10 most recently surveyed museums have been generated directly from the database. The database is still being refined to increase its usability for the surveyor, to ensure that it is capturing useful information, and to produce a range of types of reports.

Publications:

Division: PCS

Number:

Title:	**Quantification of the Effects of Controlled Atmosphere and Thermal Treatments as Pest Control Measures for Museum Objects**
Purpose:	To improve the understanding of the effects of non-chemical pest control methods on museum objects.
Dates:	July 1999 to December 2002
Team:	Tom Strang
Description:	The use of chemical methods for pest control in museums has been declining over the past 10 years, and have been replaced to a large extent by controlled atmosphere fumigation (carbon dioxide, nitrogen, or argon) or by thermal treatments (low-temperature or high-temperature treatments). To assist collection managers in the choice of method for the extermination of insect infestation from collections, the efficacy of these treatments has been largely reviewed. Questions raised by conservators now focus on the response of objects to the treatments. Both literature review and laboratory experimentation are required to answer these questions.
Users:	Collection managers, conservators, pest control companies.
Links/Partnerships:	
Results:	
Publications:	
Division:	PCS
Number:	

Title:	**Design of a Bag Utilizing Solar Energy for Pest Control**
Purpose:	To design and characterize a bag which will allow solar heating of the contents in such a way that thermal de-infestation of the bag contents will be achieved.
Dates:	1996 to September 2000
Team:	Tom Strang
Description:	High-temperature treatments (slightly in excess of 40□C) of museum objects have been proven to be efficacious. Preliminary experiments have indicated that solar heating of an enclosure in Ottawa, even during the fall, will provide sufficiently high temperatures to achieve high mortality rates for pest-infested objects. While a prototype has shown the feasibility of the idea, additional tests need to be carried out to assess various materials and configurations over periods of several days through various seasons. Monitoring of the conditions inside the enclosure will be carried out to determine the temperature and relative humidity characteristics, and the temperature gradients, within the enclosure.
Users:	Collections managers, conservators, with low budgets. May be of particular interest to those in tropical regions, although should also be viable in more temperate regions.
Links/Partnerships:	
Results:	
Publications:	
Division:	PCS
Number:	

Title:	**Effects of Vibration on Small Canvas Paintings**
Purpose:	To provide a detailed summary of the risk that vibration poses to paintings.
Dates:	April 1998 to December 1999
Team:	Paul Marcon*
Description:	The effects of vibration on paintings is poorly understood. An improved understanding of this risk will allow shipping hazards to be more realistically assessed, and the relative importance of vibration compared to other shipping hazards to be determined. Features of protective packaging and painting treatments (e.g. wrapping, crating, backing boards) will be assessed in terms of their ability to reduce the vibration sensitivity of the canvas.
Users:	Conservators, packers, exhibition designers, museum and art gallery managers, shippers.
Links/Partnerships:	
Results:	Sample paintings have been fabricated and preliminary experiments run. Vibration fixtures and documentation (photographic) procedures have been refined for a series of vibration experiments to acquire additional data.
Publications:	
Division:	PCS
Number:	

Title:	**Design of Windows-based Software to Assist with Package and Cushion Design - PadCAD 3D**
Purpose:	To design an easy-to-use software tool which will lead to improved protection of museum objects in transit.
Dates:	April 1998 to June 1999
Team:	Paul Marcon,* Tom Strang
Description:	Effective package design for transporting museum objects is a challenge for many museums and art galleries. Many objects are transported each year with inadequate protection, and while most survive due to either good handling or good luck, some are damaged. Even museums with experienced packers may not be getting optimal protection for their artifacts. The original version of PadCAD gave some basic recommendations on foam selection. PadCAD 3D is a Windows-based software program which guides a user through the various steps of package design. The user inputs the dimensions, the weight of the object and its fragility, and then selects the type of packing case to be used and the configuration of packing foam. The program then gives a listing of the possible foams that will give the desired level of protection or better. Once a foam has been selected, the program gives a cut list for the foam, and gives predictions of the total level of protection, the thermal half-time, and the total package weight. It can also calculate the frequency damping characteristics for critical elements of the object. Various combinations of packing cases and foam configurations can easily be calculated to find the one that best suits the user's needs.
Users:	Preparators, shippers, conservators, commercial package designers.
Links/Partnerships:	
Results:	PadCAD 3D in beta testing April 1999.
Publications:	CCI Newsletter article 1998.
Division:	PCS
Number:	

Title:	**Coatings for Display and Storage in Museums**
Purpose:	To develop and update the understanding of coatings used in museums and to assist our clients in making better choices in the selection of coatings in display and storage areas.
Dates:	April 1994 to June 1999
Team:	Jean Tétreault
Description:	Coatings are often used for preservation purposes, e.g. coating the interior of a display case is a situation that museums must deal with regularly. However, the requirements for coatings for preservation purposes differ from those for domestic or industrial use. Direct contact with unsuitable coatings, or the emission of harmful volatile compounds from coatings, can damage precious artifacts. Therefore, the section of appropriate coatings poses a challenge in conservation. The goal of this project is to produce a technical bulletin represented the state of art of the knowledge on coatings used in museums and can get largely diffuse. Many spot tests will be also included.
Users:	Conservators of all disciples, curators, designers, contractors.
Links/Partnerships:	
Results:	Experimental work completed. CCI Technical Bulletin written and with CCI publications unit. Proposed title " Coatings for Display and Storage in Museums, CCI Technical Bulletin No. 21."; available summer 1999
Publications:	Tétreault J. and E. Stamatopoulou. "Determination of Concentrations of Acetic Acids Emitted from Wood Coating in Enclosures." *Studies in Conservation*. 42 (1997): 141-156.
Division:	PCS
Number:	

Title:	**Cellulose Degradation in an Acetic Acid Environment**
Purpose:	To assess the potential impact of using acid emissive materials with cellulosic materials
Dates:	April 1997 to December 1999
Team:	Jean Tétreault* and Anne-Laurence Dupont
Description:	Paper-based cultural heritage is often exposed to indoor organic pollutants. Wood products, coatings, silicone-based sealants, and poly(vinyl acetate) adhesives all emit acetic acid. Although the effect of acetic acid environments on metals, calcium-based materials, and acetate-based films has been studied in recent years, little research has been done on paper-based materials. Acetic acid likely causes hydrolysis of cellulose polymers, but the action of weak acids on cellulose has not been investigated to the same extent as that of strong acids. The aim of this project is to assess the effect of acetic acid vapour on cellulose paper using cold extraction pH and viscometric determination of degree of polymerization (DP) of cellulose dissolved in cadoxen. A system of acetic acid – water – salt is used to generate acetic acid in vapour phase in hermetically closed desiccators.
Users:	Paper and textile conservators, conservation scientists, and archivists.
Links/Partnerships:	Harvard University Library
Results:	Experimental work completed and submitted for publication. In review.
Publications:	Dupont, A-L. and J. Tétreault. "Cellulose degradation in an acetic acid environment." submitted to Studies in Conservation.
Division:	PCS
Number:	

Title:	**Development of a Relative Humidity Control Module using Commercially Available Components**
Purpose:	To produce effective, large capacity humidity control for any desired relative humidity (RH) for a series of display cases at a fraction of the cost of building level installations.
Dates:	January 1998 to December 1999
Team:	Stefan Michalski,* Paul Marcon, Tom Strang
Description:	Control of relative humidity (RH) within museums and galleries continues to be an expensive and difficult challenge. In many situations, an attractive option is to control the RH within display cases, as opposed to controlling the entire gallery space. The concept of a centralized module is that filtered and humidity-controlled air is supplied to each case via small tubes (typically 6 mm diameter) without return air, relying on compensating leakage from the case. A previous design for an RH control module to control the RH in multiple cases has been successfully implemented in a number of galleries, but fabrication of these units from blueprints was generally a major stumbling block in implementing this solution. The current approach is to use commercially available components (humidifier and dehumidifier), which should facilitate the fabrication and installation of these modules. A standard approach to use in sizing of the units, fans and tubing, and design of the buffer column need to be developed. A microcontroller is be[illegible] evaluated as the module controller. The possibility of using an Internet application to provide remote control of the module and remote monitoring of the unit's performance is being investigated.
Users:	Large, small, and medium-sized museums.
Links/Partnerships:	Newfoundland Museum, National Museum of Science and Technology
Results:	Partners have been selected for the prototyping of this approach and one set of commercial units have been purchased. Testing of these commercial components with fans and buffering columns is currently underway.
Publications:	
Division:	PCS
Number:	

Title:	**The Establishment of Standards for Light Exposure and the Vulnerability of Materials to Light in Museum Conditions**
Purpose:	To develop a standard which will be both consistent with previous work done in assessing the vulnerability of museum objects, but will also lead to a more rational application of lighting guidelines for heritage objects.
Dates:	January 1998 to October 1999
Team:	Stefan Michalski*
Description:	Standard light levels have been in place in museums over the past 30 years, and while the intent of the standards is clear and rational, its application to broad ranges of object types has been somewhat arbitrary. The issue of visibility vs. vulnerability of the object has been a difficult one for the conservation community, and clearer guidelines are needed. CCI has been working with a committee to develop an improved lighting guide for museums to be adopted by the International Commission on Lighting (CIE). This guide will outline steps to be followed in lighting museum displays, including classifying all exhibits according to a four-category scale outlined in the document, determining the acceptable level of ultra-violet radiation, lighting the display ensuring that illuminances are no greater than necessary to satisfy display objectives, and finally to calculate the annual exposures and plan for the maximum duration of the display, both for the exhibition and for individual objects at risk (again using guidelines outlined in the document).
Users:	Conservators, exhibit designers, lighting designers.
Links/Partnerships:	Technical Committee 3-22 of the International Commission on Lighting (CIE)
Results:	Production of a chart entitled "Artifacts and Lighting: Visibility vs Vulnerability" for use in teaching and presentations developed in 1998. Draft "Guide on Museum Lighting and Protection against Radiation Damage" submitted to the CIE for approval early in 1999; draft scheduled to be ratified in autumn 1999.
Publications:	"The Lighting Decision", in *Fabric of an Exhibition,* Preprints of Textile Symposium '97, Canadian Conservation Institute, Ottawa, 1997, pp.97-104
Division:	PCS
Number:	

Title:	**Airtightness of Enclosures**
Purpose:	To provide in situ tools to locate leaks and to measure leakage rate of enclosures. This tool will be important for the simulation of volatile compounds in enclosures and for correct sizing of relative humidity control measures.
Dates:	April 1999 to March 2001
Team:	Jean Tétreault*, Stefan Michalski*
Description:	It is recommended that enclosures such as display, storage and transportation cases must be as airtight as possible for optimal protection of objects. This airtightness provides protection against outdoor pollution, water, dust and insects. The control of relative humidity is also simpler in airtight enclosures. There are a number of tools which are used commercially or have been used in conservation applications to determine display case or storage cabinet leakage. The goal of this project is to assess these tools and look at other possible approaches, and then to develop a kit with one or more tools for localizing leaks and for measuring leakage rate of enclosures by doing pressure, ultrasonic and tracer gas measurements.
Users:	Conservation scientists, conservators all disciples, curators, designers, contractors.
Links/Partnerships:	
Results:	Preliminary experiments were done with pressure and tracer gas measurements.
Publications:	Michalski, S., 'Leakage prediction for buildings, cases, bags and bottles', *Studies in Conservation* 39 (1994) 169–186.
Division:	PCS
Number:	

Title:	**Mathematical Modelling of a Volatile Compound in Enclosures**
Purpose:	The goal of this project is to develop a model able to simulate a volatile compound in an enclosure under the influence of many environmental parameters such as outside environment, leakage, absorbent and emissive materials.
Dates:	April 1998 to March 2003
Team:	Jean Tétreault*
Description:	There are mathematical models which predict the distribution and concentration of pollutants in a building. However, few models exist for pollutant evolution in enclosures such as display cases, storage boxes or cabinets. Understanding the behaviour of pollutants in enclosures is important since most valuables are stored or displayed under these conditions. The elaboration of this mathematical model should lead to better understanding of absorption and desorption phenomena on materials or artefacts, better understanding of the influence of the environmental parameters on the volatile compound levels in enclosure, and should also allow the prediction of volatile compounds including water vapour in an enclosure.
Users:	Conservation scientists, conservators, curators, designers, contractors.
Links/Partnerships:	Patrick Oliviers, Michel Therrien
Results:	Software development and simulation of a volatile compound in airtight enclosure.
Publications:	
Division:	PCS
Number:	

Title:	**Development of a Packing Case Standard for Use in Shipping Works of Art**
Purpose:	To develop a standard set of performance criteria for packing cases used to ship works of art, to provide clear guidelines as to the important elements, and to allow the development of a standard testing protocol for fine art packing cases.
Dates:	April 1999 to August 2000
Team:	Paul Marcon*
Description:	Many different packing case designs are currently in use, and there is presently no means of assessing the performance of any given packing case. It would be useful to develop a set of performance standards that were generally agreed upon by the community, so that packing cases could be designed to meet these criteria, and their performance could be assessed against them. The approach will be to evaluate the effectiveness of control features of packing cases for controlling physical and other agents of deterioration. This will include standard tests (such as those already accepted by the American Society for Testing of Materials, ASTM) and conservation-specific tests.
Users:	Case fabricators, museum preparators, conservators, shippers
Links/Partnerships:	
Results:	Project is in the planning stages. A request has been received from a commercial fine art transporter for evaluation of the characteristics of a new shipping case design.
Publications:	
Division:	PCS
Number:	

Title:	**Evaluation of soot-removal from inorganic and organic materials using an Nd-YAG laser**
Purpose:	Develop expertise and experience of with the use of the Nd-YAG laser. Develop expertise and experience with analytical methods to assess the results of laser-cleaning on different types of materials. Provide information and supporting data on the use and analytical assessment of Nd-YAG laser-cleaning. Contribute to the adoption and use of Nd-YAG or other infrared laser-cleaning techniques amongst Canadian conservators, if these techniques prove to be appropriate in conservation.
Dates:	February 1997 to March 2000
Team:	Carole Dignard*, Gregory Young, Paul Heinrichs, Thomas Stone, Heather Garrod (Parks Canada)
Description:	Nd-YAG laser-cleaning is being practised since the early 1990s in Europe, but is still not widely known and used in North America. Besides its high cost, one of the major reason for its limited use up to now is that the effects on the materials are still not well known or understood. Little information has been published on the assessment of Nd-YAG laser-cleaned organic materials, in particular. In light of this, tests were performed on a variety of soot-covered materials, mainly organic, using an Nd-YAG laser at the NRC. Fluence (energy density) and repetition rate (frequency) were varied incrementally. The results will be given in terms of efficiency of the cleaning as well as any adverse effects such as yellowing or physical damage, as assessed by microscopic or SEM analysis.
Users:	Conservators in Canada and abroad
Links/Partnerships:	Partnership within CCI between Treatment and Development (Dignard, Heinrichs and Stone) and Conservation Processes and Material Research (Young). Partnership with Parks Canada (Garrod). Partnership with NRC during the test period (Feb.-April 1997).
Results:	Tests at the NRC are finished. Microscopical analysis and photography are finished. SEM analysis is ongoing. Writing of the paper for publication is ongoing.
Publications:	'An Overview of Laser Cleaning in Conservation', oral talk presented at the CAC conference, May 1997. 'Overview of Laser Cleaning in Conservation', Poster Session presented at the CAC conference, May 1997, giving preliminary assessment of the NRC tests. 'Report: Nd-Yag Laser-Cleaning at CCI: Experiences, Results and Directions'. Report presented to CCI management in July 1997.
Division:	T&D
Number:	

Title: **Comparison Between Cotton and Linen Textiles and Paper: Effect of Washing, Deacidification, Peroxide and Borohydride Bleaching, Enzyme and Rust Removal Treatments**

Purpose: Textile conservators will be able to appropriately apply the research results obtained for paper to cellulosic textiles. CCI will be able to use existing knowledge gained from paper conservation treatment research to develop research necessary for cellulosic textiles.

Dates: 1998- 1999

Team: Jan Vuori, Season Tse

Description: Washing, deacidification, bleaching and enzyme treatments have been well researched for applications on paper artifacts. A great deal of this research was carried out at CCI. However, many textile conservators have reservations in the direct application of results from paper research because of the differences between the two types of substrates. The results from the Water Washing project (CPRES 017) suggest that textiles are less sensitive to the positive or negative effects of water washing and low concentrations of magnesium sulphate and carbonate. In order to establish this 'link' between paper and cellulosic textiles, this project will review existing literature on deacidification, peroxide and borohydride bleaching, enzyme treatments and the use of commercial rust-removers on cotton and linen textiles. It will also evaluate the effectiveness of these treatments when apply with the ultrasonic mister and suction devices. This project aims to help textile conservators apply these paper conservation treatments to cellulosic textiles.

Users: Textile conservators & CCI

Links/Partnerships: 1986 Paper and textile research focus group report, 1995 Textile research focus group report, Discussed with Jane Merritt and Robin Hanson (US Parks Service, Harpers Ferry Centre) both feel that this is a crucial step in order to define what is needed in future cellulosic textile treatment research

Results: Literature review showed that existing research has already established the beneficial effects of deacidification and borohydride treatments on cotton and linen textiles. Areas that need more work include application of enzymes on textiles, establishing methods to assess removal of borohydride bleach, assessment of the effect of commercial rust-removers such as Rust-go on cellulosic textiles if treatment is done using a suction device. In the past year, sodium borohydride was used successfully to remove stains from two linen artifacts by Debra Daly-Hartin and Jan Vuori. pH measurements were used as a means to detect residual borohydride bleach. Pre aged cotton and linen test fabrics and stained fabrics were prepared for treatment evaluation.

Publications:

Division: T&D

Number:

Title: **Evaluation of the effects of stain removal methods using the suction disk on cellulosic and silk textiles**

Purpose: To gain experience with the use of the suction devices: what works and what doesn't. To provide information and supporting data for the development of a workshop/seminar on local stain-removal using suction devices. To develop a method for local heat ageing which can be use to evaluate spot treatments on artifacts.

Dates: 1998-2001:

Team: Jan Vuori, Debbie Daly-Hartin, Season Tse

Description: The usefulness of suction devices for local stain removal have long been established for treatment of paper. There are less successes with treatment of textiles. This is mainly due to differences in fibre structure which require higher suction that most commercially available devices cannot deliver.

This is an ongoing activity as CCI conservators develop expertise in using the suction table for cleaning and stain removal. My role is to provide information, suggest methods of treatment, evaluate the effectiveness of a reagent and removal methods, and, when necessary, assess possible degrading effects on the substrates.

An important part of this project is to develop a method for local heat ageing in order to provide an estimate of the long term effect of local treatment on an artifact. This method is analogous to the micro-spot fading technique that is developed by Charlie and Stefan.

Users: Textile, Fine Art and Paper conservators

Links/Partnerships: At CCI, the initial development of suction devices for local spot removal of textiles is largely work of Stefan Michalski who demonstrated its use with water, detergent and solvents on textiles. The treatment of the Redlake (1997, Fine Arts) and the Matisse (1998, Textiles), necessitate the use of other stain removers such as reducing bleaches and deacidification solutions with suction devices.

Work prompted by 1986 Paper and textile research focus group report, 1995 Textile research focus group report. Discussed textile research with Chris Paulocik (Metropolitan Museum of Art, Costume Institute) during Symposium 97, who indicated that research in stain removal for textile collections the most needed area.

Results:

Helped developed the treatment for the *Legend of the Red Lake* and *Océanie, la Mer* by Matisse, using sodium borohydride. In both artifacts, sodium borohydride was effective in removing the disfiguring stains.

Worked with Debbie Daly-Hartin to determined a suitable borohydride concentration, treatment times, rinsing procedures and detection of borohydride residue. Debbie found that water rinsing with air-brush was much more effective in removing residual borohydride for certain type of fabrics. She has submitted a paper to ICOM 99 describing this novel treatment.

Jan Vuori used the ultrasonic mister to deliver the bleach on the Matisse, followed by rinsing with water delivered as liquid as well as via the air-brush. This combination of devices achieved excellent results both in controlling the delivery of the bleach and ensure thorough rinsing.

pH measurements of test linen pieces were carried out to evaluate the rinsing procedures. The results are documented in CPMR report #832

Different rust-removers were used on the suction table to remove iron stains. Rust-go (12% hydrofluoric acid) and oxalic acid are most effective. However, the effect of short term exposure of old textiles to such strong acids is unknown. CPMRES 056 will attempt to address this.

Local heat ageing device: building a prototype of heat-sensing pad that can monitor the temperature of heated spatulas and tacking irons.

Publications:

Division: T&D

Number:

Title:	**Digital recording and reproduction of original decals from industrial collections.**
Purpose:	To create detailed digital records of rare decals to save them from extinction; to allow the creation of reproductions of historical decals for high quality restoration projects; to foster new appreciation and awareness of intact original materials.
Dates:	June 1999 to May 2000
Team:	George Prytulak
Description:	Original decals on industrial artifacts are intricate decorative elements that are rich in artistry and historical information about the artifact's manufacturer. They are frequently destroyed by exposure to the elements and overzealous restoration work. The number of surviving decals in good condition is relatively small; once lost, they can not be recreated. A number of modern reproductions are available but they are poor substitutes and they are limited to common artifacts with a large restoration market. Moreover, most are printed on vinyl backed with pressure-sensitive adhesive rather than authentic water slide decal paper. This project will focus on the use of digital technology to record, restore and reproduce original decals on authentic backing materials. Authentic, accurate decals will raise restoration standards to a new level and enhance the interpretive value of industrial collections in museums.
Users:	Industrial/transportation and agricultural museums; private collectors and restorers; results will apply to bicycles, motorcycles, tractors, threshing machines, buses, aircraft, logging machinery, diesel locomotives, trucks, railway coaches, communications equipment, toys, etc.
Links/Partnerships:	National Museum of Science & Technology, National Aviation Museum, Canadian War Museum, Ontario Agricultural Museum
Results:	Historical research pertaining to technology of early decals; survey of manufacturers of reproduction decals; slide collection spanning 15 years.
Publications:	
Division:	T&D
Number:	

Title: **CCI Lining Project; Phase III - Assessment of the Performance of Lining Supports on Model Paintings**

Purpose: To assess the effectiveness of selected lining supports to dominate the stiffness in a painting and in so doing, to support the stresses in a painting in response to both short-term strain (shock) and long term strain (cupping and cracking, RH and T change). This will assist the conservator in making the most appropriate choice of lining fabric for a particular painting.

Development of a standard experimental procedure will allow comparative testing of additional lining supports as well as less interventive methods of structural stabilization.

Dates: August 1999 to August 2002

Team: Debra Daly Hartin*, Stefan Michalski

Description: The Lining Project is a long-term project to study the behaviour of various lining systems and to investigate their ability to minimize defects in a painting. The previous research of Marion Mecklenburg and Gerry Hedley increased our understanding of the mechanical behaviour of paintings and lining supports and as a result, new fabrics such as polyester, are being used as lining supports. Are these supports behaving as we think they are in supporting the stresses in a painting?

The first phase of the project involved the measurement of the mechanical properties (tension and change in dimension (published), stress relaxation and modulus of elasticity (unpublished)) of model paintings under different conditions of relative humidity. The second phase investigated the bond strength of a BEVA 371 flocked adhesive and a wax-resin adhesive with different lining supports using 180□ peel tests.

In this final phase of the project, selected lining systems are being tested in terms of their ability to reduce cracking, delamination, cupping and sagging due to stretching, stress relaxation, and humidity and temperature fluctuations. Tension has been monitored continuously in uniaxial samples which have been exposed to 50%RH, 12%RH for several months and returned to 50%. Models used for analysis of the data have been taken from viscoelastic/plastic polymer mechanics. Equipment modifications must be made before testing continues at low temperature. Repetitive testing will be undertaken on additional samples to verify consistency of results. Future work will involve the testing of biaxial samples which have already been prepared.

Users: Painting conservators and researchers involved in the mechanical behaviour of paintings and structural treatment techniques for paintings on canvas.

Links/Partnerships: Collaborative project between Treatment and Development Services (Fine Art laboratory) and Preventive Conservation Services; Linkage with Furniture and Decorative Art laboratory for the equipment design and fabrication and Conservation Processes and Materials Research for Adhesive Testing Program. External linkages with other researchers working in the field, particularly ICOM-CC (Painting Group I).

Results: Stress relaxation is an important criteria for lining supports. Viscoelastic polymer mechanics explains the rates of relaxation of the different layers of a lined painting.

Lining with unimpregnated linen or a multifilament polyester fabric offered no significant support to the model paintings prepared with lead white oil grounds.

A lining with unimpregnated polyester sailcloth showed high initial tension and much slower relaxation than the model oil painting, so significant support was maintained. It can reduce cupping by stress alignment and can reduce cracking by some overstretching but at fast events like shock and after periods of low RH, the painting will carry the tension and will be vulnerable to defects. Several layers of sailcloth bonded together or a heavier weight cloth may extend support to these events as well.

Impregnation can increase initial tension, slow subsequent relaxation and can slow the rate of response to change in RH; a size which does not saturate the fabric only influences tension a few days after an applied strain.

Publications: S. Michalski, D. Daly Hartin, "CCI Lining Project: Preliminary Testing of Lined-Model Paintings", *Preprints 11th Triennial Meeting of the ICOM-CC*; Edinburgh, 1996

S. Michalski, D. Daly Hartin, "CCI Lining Project: Preliminary Testing of Lined-Model Paintings" poster at Conference on "Lining and Backing, The Support of Paintings, Paper and Textiles", UKIC, 1995

D. Daly Hartin, S. Michalski, "Ongoing Research in the CCI Lining Project: Peel Testing of BEVA 371 and Wax-resin Adhesives with Different Lining Supports" *Preprints of the 10th Triennial Meeting of the ICOM-CC*; Washington, 1993

D. Daly Hartin, S. Michalski "Lined Paintings - Research; Tests of Beva and Wax-Resin Linings", Gerry Hedley Memorial Forum: Mechanical Behaviour of Paintings - Experience and Theory; 1993

D. Daly Hartin, S. Michalski, C. Pacquet, "Ongoing Research in the CCI Lining Project: Peel Testing of BEVA 371 and Wax-Resin Adhesives with Different Lining Supports", *Preprints 8th Triennial Meeting of ICOM-CC*; Sydney, 1987.

Division: T&D

Number:

Title: **UV Barrier Top-Coat Applications Using Regalrez 1094 for the Protection of Light-Sensitive Varnish Substrates**

Purpose: To provide an alternative to Acryloid B-72 for the application of UV barrier top-coats. Regalrez 1094 is currently preferred for its gloss properties in many applications as a top-coat, and the testing of UV absorbers would develop and enhance its usefulness and provide a new toll for the conservation of natural resin picture varnishes.

Dates: September 1994 to December 2000

Team: James Bourdeau, Holly Fiedler, Maureen Macdonald, Nancy Binnie, Kate Helwig

Description: Regalrez 1094 is frequently used by conservators as a sacrificial top coat and gloss modifier for natural and synthetic resin picture varnishes which are sensitive to UV-initiated auto-oxidation and subsequent yellowing and mechanical deterioration. The purpose of this project is to test the UV barrier properties of Regalrez 1094 top-coats to which are added various commercial UV absorber compounds based on either substituted 2-hydroxy benzophenones or 2-hydroxy benzotriazoles. An analytical survey of polymer additives in commercial varnishes is anticipated. Subsequent work will involve examining additive migration and the effects of various additives on pigments.

Users: Conservators, conservation scientists

Links/Partnerships:

Results: This project would form part of a larger commitment to the examination of aspects of contemporary surface coatings, primarily for developing options for the treatment of paintings. Research to date has resulted in the development of a very successful workshop *Contemporary Varnishes, Materials and Techniques*, which has been presented in the US, Australia and Germany with commitments for more German seminar/workshops in 1999 and 2000. This current proposal for an internship has been approved for Ms. Fiedler and results from the advice I have been giving her on her Queen's research project and thesis. The subject of her research is on the testing of the behaviour of unstabilized dammar compared to dammar stabilized with either the hindered amine light stabilizer, Tinuvin 292 or Tinuvin 123, by natural and "accelerated" aging; the behavior of Acryloid B-72 compared to Acryloid B-72 with either the ultraviolet absorber Tinuvin 327 or Tinuvin 384 is tested by natural and "accelerated" aging. This project will help to advance the work being done at CCI on this subject.

Publications:

Bourdeau, J.,"Using UV Absorbers in Acrylic Top Coats as a Remedial Treatment for Dammar Varnishes Containing Irganox 565," in *Varnishes - Authenticity and Permanence*, eds, L. Carlyle and J. Bourdeau, Archetype, London, 1999

Bourdeau, J., "Phenolic Antioxidants, Stabilizers, and UV Absorbers: Theory and Applications," and "The Use of Paraloid B-72 as a UV- Barrier Top Coat," in *The Painting Conservation Catalogue, Varnishes and Surface Coatings*, The American Institute for Conservation, Washington, D.C., 1998

Bourdeau, J., "Practical Considerations in the Use of Acrylic UV Barrier Top Coats for the Protection of Dammar Picture Varnishes," preprints of the annual conference of the *Arbeitgemeinschaft Der Resauratoren*, Bremen, Germany, October 9-13, 1995

Division: T&D

Number:

Title:	**Devise and Field Test Protective Measures for Closed Interior Areas of Outdoor Industrial Artifacts**
Purpose:	To establish practical options and advice for museums with limited budgets and limited indoor storage space to assist them in the preservation of the closed interiors of industrial artifacts.
Dates:	June 1999 to Jan 2000
Team:	George Prytulak, Maureen MacDonald
Description:	The closed interiors of industrial artifacts (airplane cockpits, passenger cars, cabs of trucks and locomotives, etc.) stored and displayed outdoors are severely damaged by prolonged exposure to direct sunlight. The enclosed areas house sensitive organic materials such as textiles, leather, plastics, rubber and paint that are subjected to excessive amounts of solar radiation, high temperatures and low RH. These interiors are essential for interpretive purposes because they are the interface between the original operators/passengers and the machines. Restoration of these areas is costly and difficult, resulting in modern replicas that are never as rich in historic detail as the originals. This project will focus on devising and field testing inexpensive, low-maintenance protective measures to reduce solar radiation and the resulting "greenhouse effect" in static aircraft on the ground. Aircraft are chosen because they present the worst case scenario; results will be applicable to other types of artifacts. These measures will include the installation of sun barrier films and the use of small exhaust fans—possibly solar-powered—within the artifacts' existing ventilation ducts to cool and ventilate the interior air spaces. Effectiveness will be measured with dataloggers. Ideally, the measures will not substantially alter the appearance of the artifacts on display.
Users:	Industrial/transportation and military museums; private collectors; results will apply to aircraft, military vehicles, diesel and steam locomotives, cars, and trucks; some application to larger interiors, e.g., buses, railway coaches, etc.
Links/Partnerships:	DND museums (Petawawa, Trenton), National Museum of Science & Technology, National Aviation Museum, Canadian War Museum
Results:	Continuous temperature and RH readings from dataloggers installed inside four aircraft during summer of 1998. Results indicate extreme daily fluctuations of air temp. (15 to 50□C) and RH (15 to 100%) daily.
Publications:	
Division:	T&D
Number:	

Title:	**Development of illuminated suction treatment devices for textiles and paper artifacts**
Purpose:	
Dates:	1998 to September 2000
Team:	Paul Heinrichs, Stefan Michalski
Description:	There has been a substantial interest in the development of useful treatment devices that exploit the benefits of suction and airflow in the treatment of paper and textile artifacts. While the basic development of the devices is carried out in a number of other projects, there is a focussed interest in supplying suction treatment devices with a safe, built in light source, that illuminates the work from below, to aid on the positioning of the suction area, and to assist in the monitoring of the treatment progress. This project will focus on the development of the light sources and will attempt to incorporate light sources into any suction device where the addition of a light source will enhance the practicality of the device.
Users:	Textile, paper, book and fine art conservators who use small vacuum devices to remove stains and adhesive residues from artifacts during treatment.
Links/Partnerships:	National Archives of Canada, Treatment and Development labs at CCI
Results:	Preliminary proof of concept devices have proven the utility of the concept, a number of devices incorporating a commercial fibre optic delivery system are proving to be the most effective delivery system. Further work will focus on adapting available fibre optic systems to new suction devices as they are developed.
Publications:	
Division:	T&D
Number:	

Title:	**Selection and field testing of solvent vapour capture devices for suction table applications**
Purpose:	
Dates:	1998 to September 2000
Team:	Paul Heinrichs, Stefan Michalski
Description:	There is an increasing use of small suction devices in the treatment of paper, textile and some fine art objects. As more conservators explore the usefulness of these devices, there is a need to utilise a range of non- aqueous solvents in the treatment process. Most practitioners route the output from the vacuum pumps that power these devices to a fume extraction system, such as a fume hood, to vent the solvent vapours to atmosphere. The installation of large central vacuum systems in some laboratories has meant that this approach must be reassessed. This project will focus on the selection and field testing on solvent capture devices that can be plumbed into the systems between the vacuum device and the vacuum source. Ideally, these devices will allow the solvents to be recycled, but at least the solvent vapours will be safely disposed of. The availability, practicality, safety and running costs of a number of devices will be assessed, compared. A number of devices will be sourced, field tested and the results reported.
Users:	Textile, paper, book and fine art conservators who use small vacuum devices to remove stains and adhesive residues from artifacts during treatment, as well as conservation facility managers .
Links/Partnerships:	National Archives of Canada, Treatment and Development labs at CCI
Results:	Discussions have been held with users to help identify their needs. A preliminary market search has provided possible sources for appropriate technology.
Publications:	
Division:	T&D
Number:	

Title:	**Design, development and evaluation of suction devices and related treatment methods for cultural objects on fabric supports.**
Purpose:	To develop expertise and experience with suction devices for the treatment of textiles including paintings and prints on fabric supports. The information and experience gathered will form part of a suction table workshop/seminar on suction treatments and will contribute to the adoption and use of the suction table amongst textile and painting conservators.
Dates:	January 1997 to September 2000
Team:	Debra Daly Hartin* (Paintings), Jan Vuori* (Textiles), Sherry Guild* (Paper), Season Tse, Stefan Michalski, Paul Heinrichs
Description:	The usefulness of suction devices for local stain removal has been well established for treatment of paper. There are fewer successes with the treatment of textiles. This is mainly because of differences in fibre structure which normally require higher suction than most commercially available devices can deliver. At CCI, the initial development of suction devices for local spot removal for textiles is largely the work of Stefan Michalski who demonstrated their use with water, detergent and solvents on textiles. The treatment of a silkscreen print on linen, "The Legend of Red Lake, Ontario", (1997, Fine Arts) and the silkscreen by Matisse "Océanie, La Mer" (1998, Textiles) provided the opportunity for refinement of the equipment and procedures relative to actual treatments. Developments have also been made with regards to various materials and procedures such as reducing bleaches, deacidification solutions, reagent delivery and rinsing techniques associated with suction devices. This is a continuing activity as CCI conservators develop expertise in using the suction tables and continue to improve the suction devices themselves. Research by conservation scientists will provide information on methods of treatments, evaluate the effectiveness of reagents, and when necessary, assess possible degradative effects on the substrates.
Users:	Textile, paintings and paper conservators.
Links/Partnerships:	Initial internal partnerships within CCI between Treatment and Development (T&D) laboratories (Fine Arts, Textiles, Paper and Furniture Sections), Conservation Processes and Material Research (CPMR) and Preventive Conservation Services (PCS).
Results:	Initial testing, experience and refinement led to the development of stain removal treatments for two silkscreen prints on fabric supports; "Legend of Red Lake, Ontario" by Josh Kakegamic and "Océanie, La Mer" by Matisse. The treatments involved the use of sodium borohydride, a reducing bleach which does not degrade cellulose, the textile suction table, the suction disk, ultrasonic mister and airbrush. Treatment reduced the visual impact of the stains to an acceptable degree and removed the decolorized materials and residual bleach from the fabric.

Publications: D. Daly Hartin, S. Tse, J. Vuori "A collaborative treatment: Reducing water stains on a silkscreen on linen" *Preprints of 12 th Triennial Meeting of the ICOM-CC*; Lyon, 1999

J. Vuori, D. Daly Hartin, S. Tse, A. Maheux, A. Ruggles "Local Stain Removal from Océanie, la mer by Henri Matisse: the development of a reducing bleach technique using a suction disk, ultrasonic mister, and airbrush" To be published in the Preprints of the North American Textile Conservation Conference 2000: Conservation Combinations.

Division: T & D

Number:

Title:	**Evaluation of Stain Removal Reagents on Cellulosic Textiles and Paper: Effect of Washing, Deacidification, Peroxide and Borohydride Bleaching, Enzyme and Rust Removal Treatments**
Purpose:	Textile conservators will be able to appropriately apply the research results obtained for paper to cellulosic textiles. CCI will be able to use existing knowledge gained from paper conservation treatment research to develop research necessary for cellulosic textiles.
Dates:	1998- 1999
Team:	Season Tse, Jan Vuori, Debra Daly-Hartin
Description:	Washing, deacidification, bleaching and enzyme treatments have been well researched for applications on paper artifacts. A great deal of this research was carried out at CCI. However, many textile conservators have reservations in the direct application of results from paper research because of the differences between the two types of substrates. The results from the deionized water washing projects suggest that textiles are less sensitive to the positive or negative effects of water washing and low concentrations of magnesium sulphate and carbonate. In order to establish this 'link' between paper and cellulosic textiles, this project will review existing literature on deacidification, peroxide and borohydride bleaching, enzyme treatments and the use of commercial rust-removers on cotton and linen textiles. It will also evaluate the effectiveness of these treatments when apply with the ultrasonic mister and suction devices compared to immersion. This project aims to help textile conservators apply these paper conservation treatments to cellulosic textiles. This is an ongoing activity as CCI conservators develop expertise in cleaning and stain removal. Current research will provide information, suggest methods of treatment, evaluate the effectiveness of a reagent and removal methods, and, when necessary, assess possible degrading effects on the substrates.
Users:	Textile, Fine Art and Paper conservators
Links/Partnerships:	1986 Paper and textile research focus group report 1995 Textile research focus group report Discussion with textile conservators: this is a crucial step in order to define what is needed in future cellulosic textile treatment research

Results:

Literature review showed that existing research has already established the beneficial effects of deacidification and borohydride treatments on cotton and linen textiles. Areas that need more work include application of enzymes on textiles, establishing methods to assess removal of borohydride bleach, assessment of the effect of commercial rust-removers such as Rust-go on cellulosic textiles if treatment is done using a suction device. Pre aged cotton and linen test fabrics and stained fabrics were prepared for treatment evaluation.

Different rust-removers were used on the suction table to remove iron stains. Hydrofluoric acid (12%) and oxalic acid were found most effective. However, the effect of short term exposure of old textiles to such strong acids is unknown and will be addressed by current research project. The first study compares the degree of degradation caused by immersion in hydrofluoric (12%), oxalic acids (5%) on cotton, linen, and paper to thiocyanate/EDTA.. Degradation is measured using viscometry and colour.

Publications:

Division:

Number: